Design Analysis Report
for
Final Design Submission Remedial Action at Operable Unit 1 (Sites 4 and 5)

Naval Weapons Station Earle
Colts Neck, New Jersey

Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0289

November 1997

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DESIGN ANALYSIS REPORT
FOR
FINAL DESIGN SUBMISSION
REMEDIAL ACTION AT
OPERABLE UNIT 1 (SITES 4 AND 5)

NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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Naval Facilities Engineering Command
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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of the Design Analysis Report (DAR) is to provide the basis of design for remedial actions at Operable Unit 1 (OU-1) at the Naval Weapons Station Earle (NWS Earle), in Colts Neck, New Jersey. This DAR was prepared by Brown and Root Environmental (B&R Environmental) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract No. N62472-90-D-1298, Contract Task Order 0289.

1.2 BACKGROUND

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles south of New York City. Sites 4 and 5, which comprise OU-1, were historically used by the Navy for disposal of municipal and industrial wastes. After disposal activities at each of these sites were discontinued, each site was graded and revegetated.

A series of remedial investigations were conducted to determine the nature and extent of contamination at Sites 4 and 5. The results of these investigations concluded that groundwater in the vicinity of each site was impacted by metals and organic compounds. A feasibility study was later conducted for Sites 4 and 5 to determine potential remedial actions for the sites. The selected remedial action for Sites 4 and 5 were presented in the Proposed Plan for OU-1, dated March 1997. The Proposed Plan selected capping as the preferred remedial alternative, consistent with the EPA presumptive remedy for municipal landfills at military installations. The Record of Decision for OU-1, dated July 1997, selected capping as the remedial action for Sites 4 and 5. Proposed remedial actions at Sites 4 and 5 included the following components:

- Installation of a low permeability cap at each site to reduce rainwater infiltration and associated leachate generation, promote surface water drainage, and provide isolation of the waste materials from humans and the surrounding environment.

- Implementation of institutional controls to restrict future use of each site as well as impacted groundwater associated with each site.

- Implementation of long-term periodic monitoring to assess contaminant status and to determine when remedial action objectives are achieved.

The purpose of the DAR is to summarize and present the results of activities related to design of landfill caps for Sites 4 and 5. The Environmental Permits Report and the Erosion and Sediment Control Plan have also been prepared and are submitted under separate cover.

1.3 DESIGN ANALYSIS REPORT ORGANIZATION

The following highlights the information contained in each section of this Design Analysis Report.

- Section 1.0 provides an introduction and summary of the basis of design.

- Section 2.0 summarizes site characteristics, including site history, and surface/subsurface soil and hydrological characteristics, and remedial investigations of NWS Earle.

- Section 3.0 summarizes site characteristics including a site history, and surface/subsurface soil and hydrological characteristics, and remedial investigations at Site 4.

- Section 4.0 summarizes site characteristics including a site history, and surface/subsurface soil and hydrological characteristics, and remedial investigations at Site 5.

- Section 5.0 summarizes the results of the Pre-Design Investigation.

- Section 6.0 summarizes design requirements for the remedial action.

2.0 NWS EARLE

2.1 BACKGROUND

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles south of New York City. The station consists of two areas, the 10,248-acre Main Base (Mainside area), located inland, and the 706-acre Waterfront area (Figure 2-1). The two areas are connected by a Navy-controlled right-of-way.

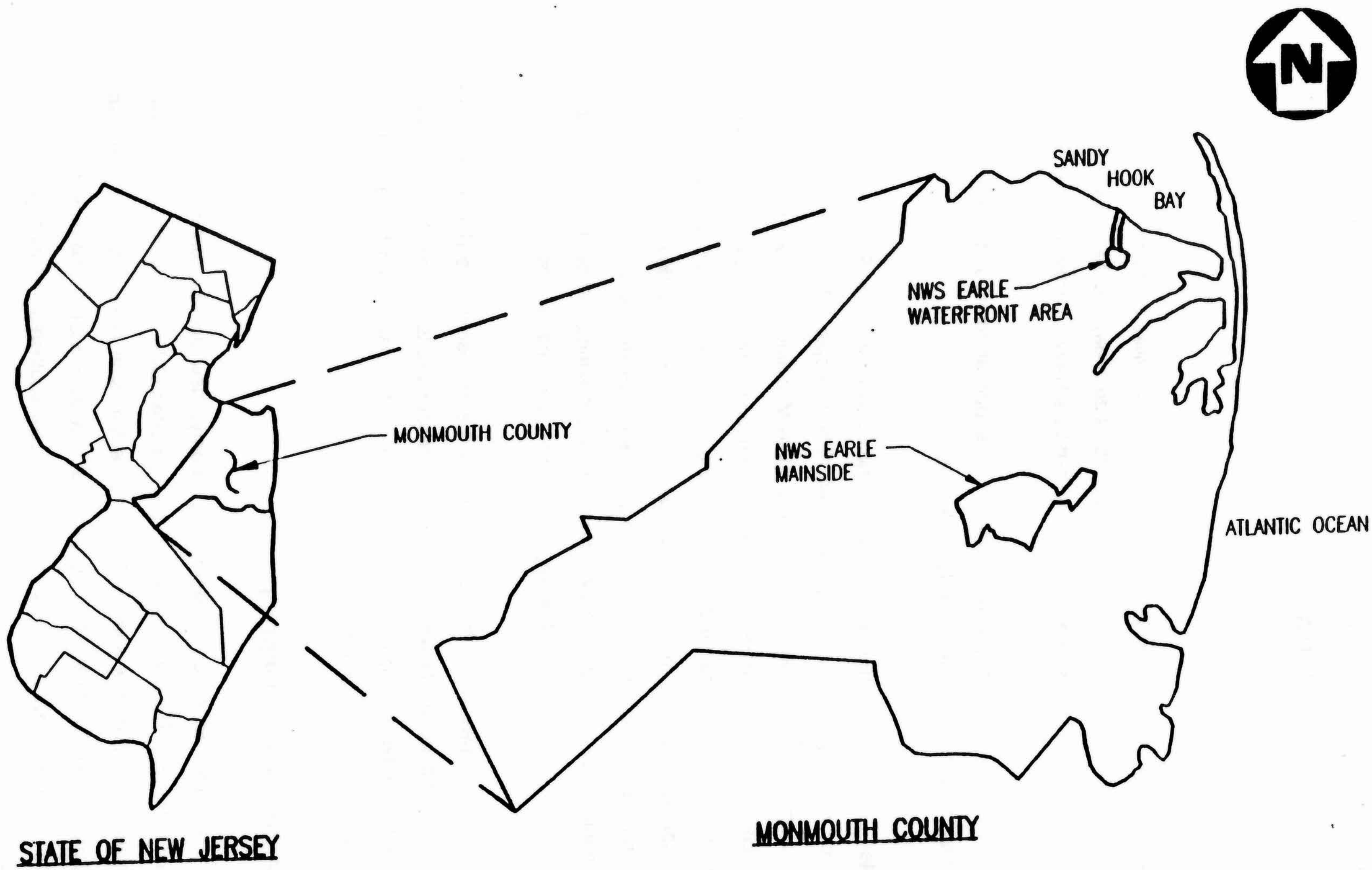
The facility was commissioned in 1943, and its primary mission is to supply ammunition to the naval fleet. An estimated 2,500 people either work or live at the NWS Earle station.

The Mainside area is located approximately 10 miles inland from the Atlantic Ocean at Sandy Hook Bay in Colts Neck Township, which has a population of approximately 6,500 people. The surrounding area includes agricultural land, vacant land, and low-density housing. The Mainside area consists of a large, undeveloped portion associated with ordnance operations, production, and storage; this portion is encumbered by explosive safety quantity distance arcs. Other land use in the Mainside area consists of residences, offices, workshops, warehouses, recreational space, open space, and undeveloped land. The Waterfront area is located adjacent to Sandy Hook Bay in Middletown Township, which has a population of approximately 68,200 people. The Mainside and Waterfront areas are connected by a narrow strip of land which serves as a government-controlled right of way containing a road and railroad.

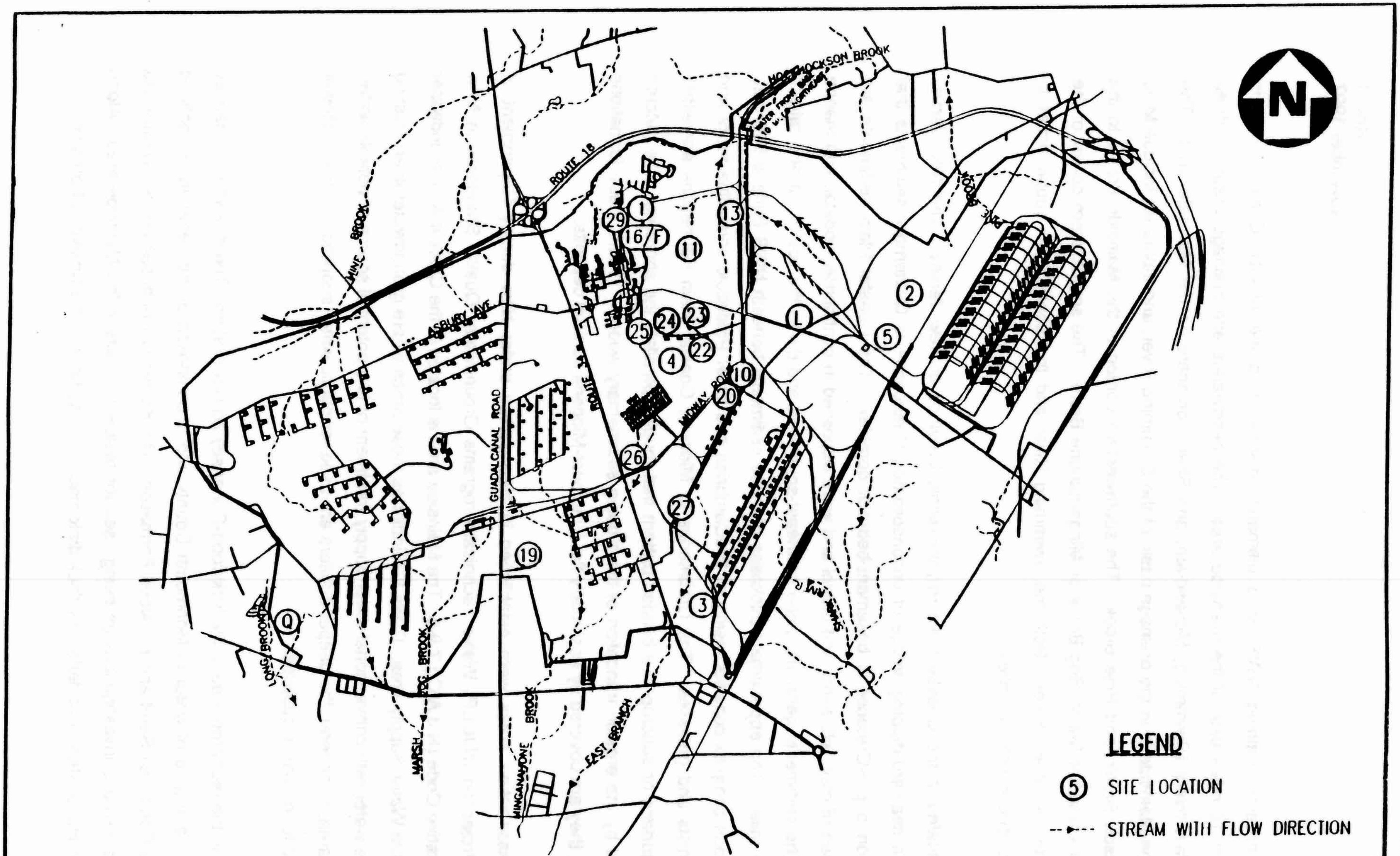
Operable Unit 1 (OU-1) consists of two former landfills located in the Mainside area (Figure 2-2): the landfill west of "D" group (Site 4) and the landfill west of the Army barricades (Site 5). The OU-1 sites were grouped together based on similarities of waste volumes, types of contaminants, and the potential for contaminants to migrate to human and/or environmental receptors.

2.2 SUMMARY OF SITE CHARACTERISTICS

NWS Earle is located in the coastal lowlands of Monmouth County, New Jersey, within the Atlantic Coastal Plain Physiographic Province. The Mainside area, which includes OU-1, lies in the outer Coastal Plain, approximately 10 miles inland from the Atlantic Ocean. The Mainside area is relatively flat, with elevations ranging from approximately 100 to 300 feet above mean sea level (MSL). The most significant topographic relief within the Mainside area is Hominy Hills, a northeast-southwest-trending group of low hills located near the center of the station.



DRAWN BY MRM — DATE 1/7/97	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
CHECKED BY RET — DATE 1/7/97	REGIONAL SITE MAP	APPROVED BY	DATE
COST/SCHED.-AREA	NAVAL WEAPONS STATION EARLE	APPROVED BY	DATE
SCALE NOT TO SCALE	COLTS NECK, NEW JERSEY	DRAWING NO. FIGURE 2-1	REV



LEGEND

⑤ SITE LOCATION

--▸-- STREAM WITH FLOW DIRECTION

0 5,000 10,000

SCALE IN FEET

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COST/SCHED.-AREA	
SCALE 1" =5000'	

Brown & Root Environmental

MAINSIDE SITE LOCATIONS
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CONTRACT NO.	OWNER NO.
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 2-2	REV

The rivers and streams draining NWS Earle ultimately discharge to the Atlantic Ocean, which is approximately 9 or 10 miles east of the Mainside area. The headwaters and drainage basins of three major Coastal Plain rivers (Swimming, Manasquan, and Shark) originate on the Mainside area. The northern half of the Mainside is in the drainage basin of the Swimming River, and tributaries include Mine Brook, Hockhockson Brook, and Pine Brook. The southwestern portion of the Mainside drains to the Manasquan River via either Marsh Bog Brook or Mingamahone Brook. The southeastern corner of the Mainside drains to the Shark River. Both the Swimming River and the Shark River supply water to reservoirs used for public water supplies.

NWS Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The New Jersey Coastal Plain is a seaward-dipping wedge of unconsolidated Cretaceous to Quaternary sediments that were deposited on a pre-Cretaceous basement-bedrock complex. The Coastal Plain sediments are primarily composed of clay, silt, sand, and gravel and were deposited in continental, coastal, and marine environments. The sediments generally strike northeast-southwest and dip to the southeast at a rate of 10 to 60 feet per mile. The approximate thickness of these sediments beneath NWS Earle is 900 feet. The pre-Cretaceous complex consists mainly of PreCambrian and lower Paleozoic crystalline rocks and metamorphic schists and gneisses. The Cretaceous to Miocene Coastal Plain Formations are either exposed at the surface or subcrop in a banded pattern that roughly parallels the shoreline. The outcrop pattern is caused by the erosion truncation of the dipping sedimentary wedge. Where these formations are not exposed, they are covered by essentially flat-lying post-Miocene surficial deposits.

Groundwater classification areas were established in New Jersey under New Jersey Department of Environmental Projection (NJDEP) Water Technical Programs Groundwater Quality Standards in New Jersey Administrative Code (N.J.A.C.) 7:9-6. The Mainside area is located in the Class II-A: Groundwater Supporting Potable Water Supply area. Class II-A includes those areas where groundwater is an existing source of potable water with conventional water supply treatment or is a potential source of potable water. In the Mainside area, in general, the deeper aquifers are used for public water supplies and the shallower aquifers are used for domestic supplies.

OU-1 is situated in the recharge area of the Kirkwood-Cohansey aquifer system. The Kirkwood-Cohansey aquifer system is a source of water in Monmouth County and is composed of the generally unconfined sediments of the Cohansey Sand and Kirkwood Formation. The Kirkwood-Cohansey aquifer system has been reported in previous investigations as being used for residential wells in the Mainside area. Along the coast, this aquifer system is underlain by thick diatomaceous clay beds of the Kirkwood Formation.

All facilities located in the Mainside Administration area are connected to a public water supply (New Jersey American Water Company). Water for the public supply network comes from surface water intakes, reservoirs, and deep wells. No public water supply wells or surface water intakes are located on the NWS Earle facility. A combination of private wells and public water supply from the New Jersey American Water Company serves businesses and residences in areas surrounding the Mainside facilities. There are a number of private wells located within a 1-mile radius of NWS Earle and several within the NWS Earle boundaries. The majority of these wells are used for potable supplies; previous testing for drinking water parameters indicates these wells have not been adversely impacted.

There is a rich diversity of ecological systems and habitats at NWS Earle. Knieskern's beaked-rush (Rynchospora knieskernii), a sedge species, has been seen on the station, and the swamp pink (Helonias bullata), may be present; both of these species are on the federal and state endangered species lists. An osprey has visited Mainside and may nest in another area at NWS Earle. The Mingamahone Brook supports bog turtles downstream of the Mainside area and provides an appropriate habitat for them at the Mainside area.

2.3 SUMMARY OF REMEDIAL INVESTIGATIONS

Potential hazardous substance releases at NWS Earle were addressed in an Initial Assessment Study (IAS) in 1982, a Site Inspection Study (SI) in 1986, and a Phase I Remedial Investigation (RI) in 1993. These were preliminary investigations to determine the number of sources, compile histories of waste-handling and disposal practices at the sites, and acquire data on the types of contaminants present and potential human health and/or environmental receptors. The RI at Sites 4 and 5 included the installation and sampling of monitoring wells, collection of surface water and sediment samples, and excavation of test pits to observe wastes and sample subsurface soils.

In 1990, NWS Earle was placed on the National Priorities List (NPL), which is a list of sites where uncontrolled hazardous substance releases may potentially present serious threats to human health and the environment. The sites at NWS Earle were then addressed by Phase II RI activities to determine the nature and extent of contamination at these sites. Activities included installation and sampling of groundwater monitoring wells, surface water and sediment sampling, and surface and subsurface soil sampling. The Phase II RI was initiated in 1995 and completed in July 1996, when the final Phase II RI report was released.

The results of the RI were used as the basis for performing a feasibility study (FS) of potential remedial alternatives. The Navy and EPA, in consultation with NJDEP, developed the proposed remedial action plan (Proposed Plan). The Proposed Plan, dated March 1997, selected capping as the preferred remedial alternative for OU-1. A Record of Decision (ROD), dated July 1997, was later issued for OU-1 and included capping as the final remedial action for Sites 4 and 5.

3.0 SITE 4 - LANDFILL WEST OF "D" GROUP

3.1 SITE DESCRIPTION

Site 4 is a 5-acre landfill that received approximately 10,200 tons of mixed domestic and industrial wastes from 1943 until the late 1960s. Disposed materials include metal scrap, construction debris, pesticide and herbicide containers, paint residues, and rinsewaters. It has been reported that containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and asbestos may have been disposed. The landfilled materials are currently covered by a thin layer of sandy soil.

Figure 3-1 depicts the location of Site 4 as well as other features such as monitoring wells and sampling locations. Figure 3-1 depicts the approximate boundary of the landfill, based on review of aerial photographs and other historical information.

An eight inch water line parallels the dirt road to the east of Site 4. An six inch lateral extends from this water line into the Site 4 landfill area. Historic drawings indicate that this lateral line serviced a fire hydrant located in Site 4. The historical drawings also indicate an elevation of the fire hydrant well above present ground surface elevation of the landfill. It is unlikely that this line is in service. The exact location of the lateral water line is not known although part of the line is exposed east of the landfill.

3.2 GEOLOGY

Regional mapping places Site 4 within the outcrop area of the Cohansey Sand. The Cohansey Sand ranges between 0 and 30 feet in thickness and the soil borings are no more than 35 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Cohansey Sand. The thickness of the sediments penetrated in the on-site borings indicates the Cohansey Sand may have a regional thickness of greater than 30 feet. In general, the borings encountered alternating beds of light-colored, silty, fine- to coarse-grained sand with varying amounts of gravel. A 0.5-foot reddish-yellow clay seam was penetrated in one of the borings

3.3 SOILS

The soils covering Site 4 are mapped as PT or Pits, sand and gravel, according to the April 1989 Soil Survey of Monmouth County, New Jersey. This unit consists of areas that have been excavated for sand and gravel. Typically, these areas consist of sandy material and differing amounts of gravel and

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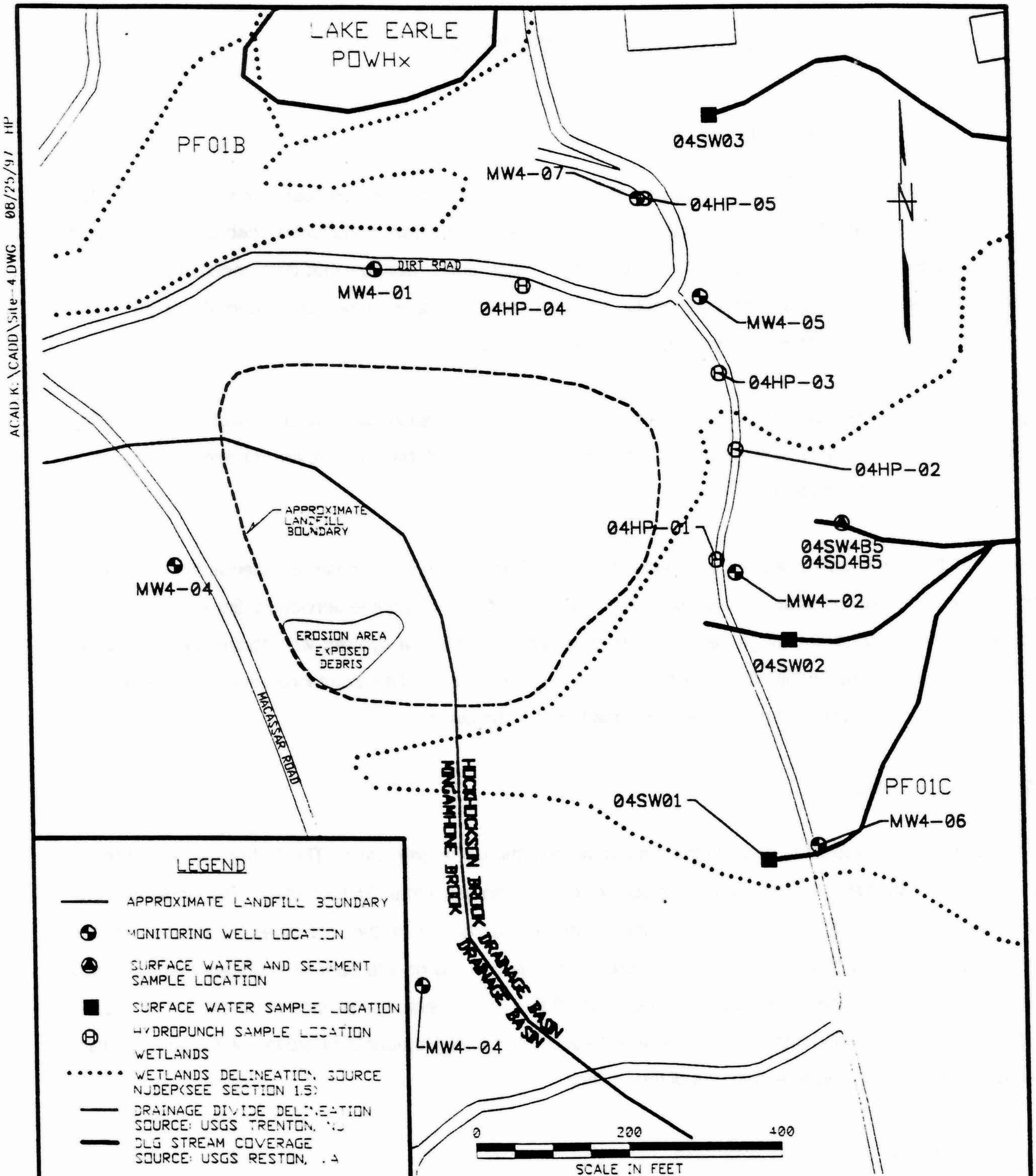


DRAWN BY HJP / DATE 8/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY / DATE	SITE 4 LANDFILL WEST OF "D" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY / DATE	
COST/SCHED-AREA		APPROVED BY / DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 3-1	REV. 0

fragments of iron-cemented sandstone. A few abandoned pits, such as the one at Site 4, have been used as landfills or dumps. The properties and characteristics of this map unit differ greatly from place to place.

Boring logs, completed during field activities at the site, indicate that the surface and shallow subsurface soil is comprised of silty, fine-grained sand with some clay. The soil's consistency is generally loose to medium dense and the soil is orange-brown to gray-brown in color.

The soil covering areas south and west of Site 4 belong to the Atsion and Lakewood series (USDA, 1989). Atsion series soils, mapped as Atsion sand, are nearly level, poorly drained soil in depressional areas and on broad flats. These soils formed in acid, sandy, Coastal Plain sediments. Permeability of the Atsion sand is moderately rapid or rapid in the subsoil and rapid in the substratum. The available water capacity is low. Runoff is very slow and erosion is a slight hazard. Most areas with this soil are wooded. Common species of trees include pitch pine, black gum, and red maple. The surface layer of the Atsion series is approximately 8 inches thick. The layer contains 2 inches of partly decomposed organic material and roots and 6 inches of black sand. The subsurface soil is grayish brown sand 14 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 4.

The Lakewood series consists of excessively drained soils on uplands. These soils were also formed in acid, sandy, Coastal Plain sediments. The mapping unit identified within the Lakewood series adjacent to Site 4 is the Lakewood sand, 5 to 10 percent slopes (USDA, 1989). Permeability of this sand is rapid in the subsoil and moderate to rapid in the substratum. The available water capacity is low and runoff is slow. The water erosion hazard is moderate, but the wind erosion hazard is severe. Most areas with this soil are wooded. Common species of trees found in Lakewood sand include pitch pine, shortleaf pine, chestnut oak, black oak, and Virginia pine. The surface layer is 4 inches thick. The uppermost inch is dark, brown, matted, decomposed organic material, and below that is light brownish gray sand 10 inches thick. The subsurface soil of the Lakewood series is light brownish gray sand 10 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 4.

The areas north and east of Site 4 are classified as Udorthents (UA). This unit consists of areas of soils that have been altered by excavating or filling. Udorthents consist of well drained to somewhat poorly drained soils that have no horizonation. These soils formed in stratified or graded, sandy or loamy fill material that has as much as 35 percent gravel by volume. Slope ranges from 0 to 3 percent.

3.4 HYDROGEOLOGY

OU-1 is situated in the recharge area of the Kirkwood-Cohansey aquifer system. The Kirkwood-Cohansey aquifer system is a source of water in Monmouth County and is composed of the generally unconfined sediments of the Cohansey Sand and Kirkwood Formation. The Kirkwood-Cohansey aquifer system has been reported in previous investigations as being used for residential wells in the Mainside area. Along the coast, this aquifer system is underlain by thick diatomaceous clay beds of the Kirkwood Formation.

Groundwater in the Cohansey aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations were recorded in August and October 1995. Groundwater contour maps are presented in Figure 3-2 (August 1995) and Figure 3-3 (October 1995). The direction of shallow groundwater flow in the aquifer is toward the east and east-southeast. There does not appear to be a significant seasonal variation in groundwater flow direction. The hydraulic conductivity calculated for MW4-04 is 4.48×10^{-4} cm/sec (1.27 ft/day).

3.5 SURFACE WATER HYDROLOGY

Site 4 is covered with a pine tree plantation, open space dominated by tall grass, and some bare areas. Site 4 is surrounded by woodlands. The ground surface slopes downward to the southeast from approximately 170 feet above mean sea level (MSL) near MW4-01 to approximately 150 feet above MSL at MW4-06. A broad, low-lying wetland extends from the eastern portion of Site 4 beyond the unpaved boundary road. Surface water flow is to the east and east-southeast toward the wetland. The southern boundary of the landfill at Site 4 parallels a drainage course which discharges into the wetlands located along the southeast corner of the landfill.

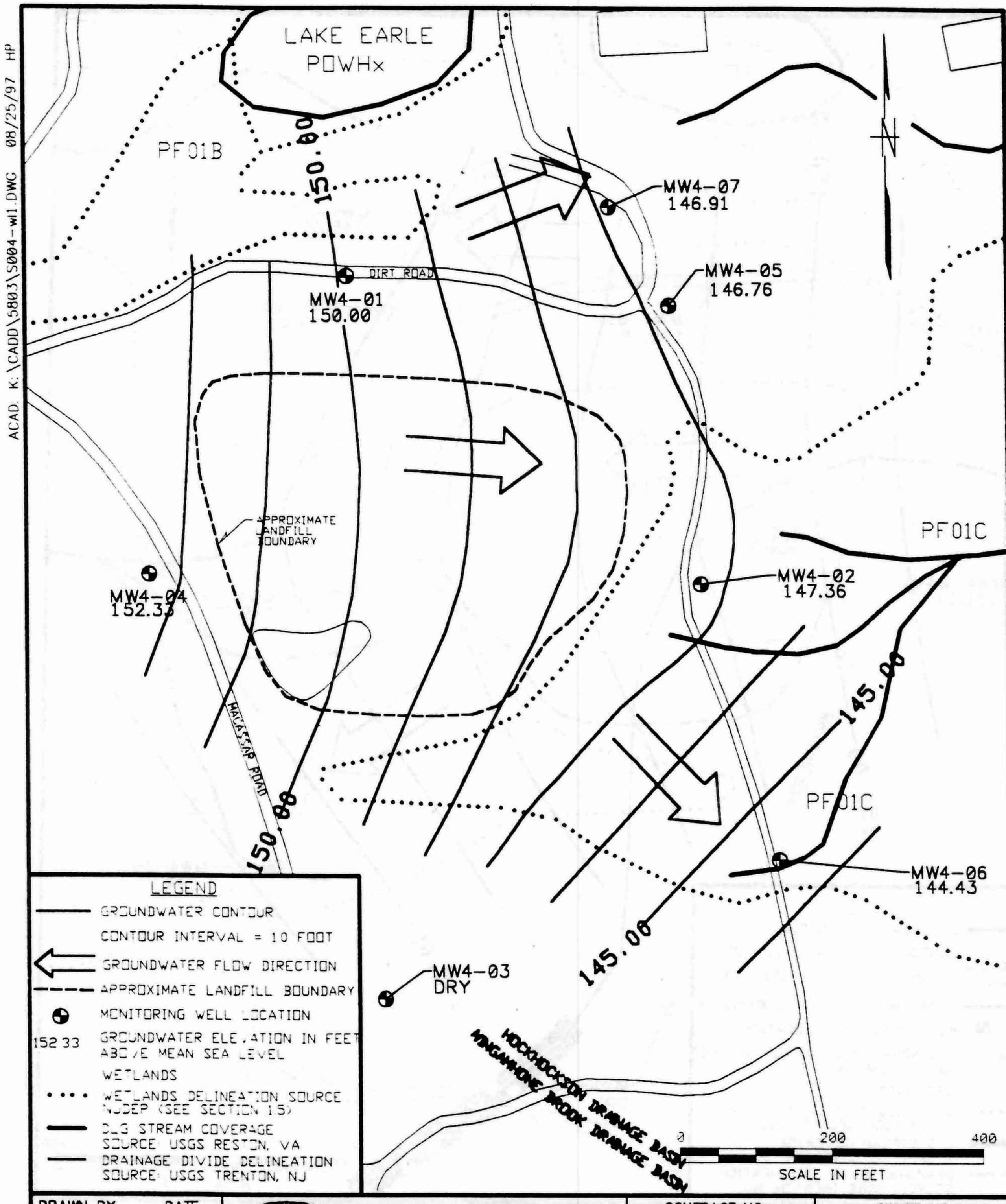
3.6 SUMMARY OF REMEDIAL INVESTIGATIONS

3.6.1 IAS and SI Results

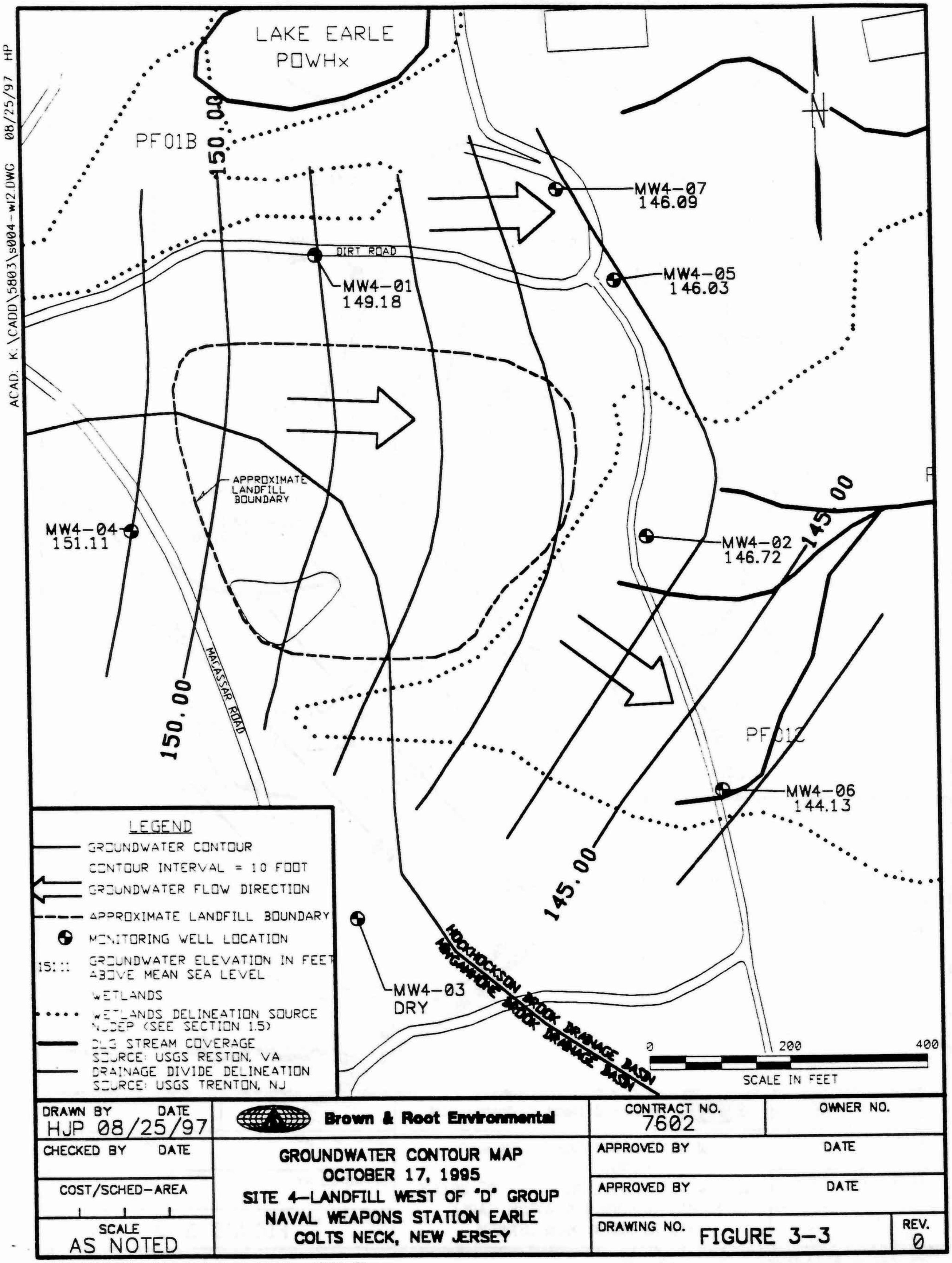
The IAS determined that hazardous materials were potentially present and could impact groundwater. The SI detected low levels of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyl (PCB), and metals in sediment samples receiving drainage from the site.

3.6.2 Phase I Remedial Investigation

During the Phase I RI, the laboratory results of groundwater samples detected VOCs, and subsurface soil samples detected elevated levels of a single pesticide and total petroleum hydrocarbons (TPH). Six test pits were excavated to characterize the waste materials in the landfill. The waste consisted primarily of metal



DRAWN BY HJP	DATE 8/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	GROUNDWATER CONTOURS MAP AUGUST 7, 1995 SITE 4 – LANDFILL WEST OF "D" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3-2	REV. 0


LAKE EARLE
POWHx
PF01B
150.00
MW4-07
146.09
DIRT ROAD
MW4-05
146.03
MW4-01
149.18
APPROXIMATE LANDFILL BOUNDARY
MW4-04
151.11
MW4-02
146.72
145.00
MACASSAR ROAD
150.00
PF01C
MW4-06
144.13
145.00
MW4-03
DRY
HOCKHOCKSON BROOK DRAINAGE BASIN
MINGAMAHONE BROOK DRAINAGE BASIN
0
200
400
SCALE IN FEET
LEGEND
GROUNDWATER CONTOUR
CONTOUR INTERVAL = 10 FOOT
GROUNDWATER FLOW DIRECTION
APPROXIMATE LANDFILL BOUNDARY
MONITORING WELL LOCATION
GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
WETLANDS
WETLANDS DELINEATION SOURCE NJDEP (SEE SECTION 1.5)
DLG STREAM COVERAGE SOURCE: USGS RESTON, VA
DRAINAGE DIVIDE DELINEATION SOURCE: USGS TRENTON, NJ
DRAWN BY HJP
DATE 08/25/97
CHECKED BY
DATE
COST/SCHED-AREA
SCALE AS NOTED
Brown & Root Environmental
GROUNDWATER CONTOUR MAP
OCTOBER 17, 1995
SITE 4-LANDFILL WEST OF 'D' GROUP
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY
CONTRACT NO. 7602
OWNER NO.
APPROVED BY
DATE
APPROVED BY
DATE
DRAWING NO. FIGURE 3-3
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scrap such as steel banding, pipes, and empty metal trash barrels. Lumber, concrete, brick, and other construction debris were also encountered. No anomalous organic vapor readings were detected in any of the test pits.

3.6.3 Phase II Remedial Investigation

Results of the Phase II RI showed the presence of VOCs, including 1,2-dichloroethene (1,2-DCE) and trichloroethene (TCE), vinyl chloride (VC), and elevated levels of metals, including aluminum, iron, lead, and manganese in groundwater. Elevated levels of metals, including aluminum, iron, lead, and manganese, and trace levels of pesticides, including aldrin and dieldrin, were detected in surface water samples. A single SVOC, nitrobenzene, was also detected at an elevated level (66.0 ug/kg) in a sediment sample. Table 3-1 summarizes the results of samples taken from groundwater compared to applicable standards.

3.6.4 Groundwater Modeling

Computer modeling estimated that Site 4 groundwater metals concentrations would gradually diminish over time, assuming a source control measure, such as capping, would be implemented to control vertical migration. The model estimated that metals concentrations at the nearest potential discharge point, a stream located approximately 400 feet downgradient of Site 4, would be well below either the state standard or background levels. The maximum distance from Site 4 where metals concentrations in groundwater would remain above applicable regulatory standards or background levels, was estimated to be 55 feet by the model. Surface water samples taken from the watershed downgradient of Site 4 currently show no concentration of compounds above background or regulatory standards.

3.6.5 Summary

In summary, results of investigations at Site 4 indicate that:

- Metals found in groundwater at concentrations above New Jersey regulatory standards were limited to aluminum, iron, and manganese. There is no promulgated federal regulatory standard for these common groundwater constituents.

- Metals concentration results may be biased high for groundwater samples collected at Site 4 because of high sample endpoint turbidity values in four of the six samples taken.

- Modeling estimated that metals in groundwater will migrate only very little, and concentrations will diminish slowly with time.

TABLE 3-1

SITE 4 GROUNDWATER
NWS EARLE, COLTS NECK , NEW JERSEY

	Maximum Exceedances	Frequency of Eceedance	ARARs and TBCs			Data Exceeding ARARs					
			Maximum Contamination Level (MCL) (ug/L)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard (ug/L)	04GW01 1995 RI 7/25/95	04GW02 1995 RI 7/26/95	04GW04 1995 RI 7/25/95	04GW05 1995 RI 7/25/95	04GW06 1995 RI 7/25/95	04GW07 1995 RI 8/22/95
INORGANICS (µg/L)											
Aluminum	2690	5/6	-	-	200	1590 J	923 J	1490 J	2690 J	578 J	
Iron	20900	4/6	-	-	300	554	20900		7680	647	
Manganese	306	1/6	-	-	50		306				
VOLATILES (µg/L)											
Trichloroethene	55	1/6	5	-	1				55		
Vinyl chloride	3	1/6	2	10e	5		3				

J = Value is estimated because the concentration is below the laboratory contract quantitation limit or because of data validation control quality criteria.
e = The listed health advisory, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TCE, found in one monitoring well at a concentration greater than the EPA and New Jersey standard, and its degradation products, found approximately at (VC) or below (1,2-DCE) the regulatory standard, indicate that contaminants leaching from the limited source area are degrading with time and are not widely spread.

4.0 SITE 5 - LANDFILL WEST OF ARMY BARRICADES

4.1 SITE DESCRIPTION

The Site 5 landfill received approximately 6,600 tons of mixed domestic and industrial wastes between 1968 and 1978 (Figure 4-1). The landfill covers an aerial extent of approximately 8 acres. Figure 4-1 depicts the approximate boundary of the landfill, based on review of aerial photographs and other historical information.

Wastes which were disposed of at Site 5 included paper, glass, plastics, construction debris, pesticide and herbicide containers, containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and small amounts of asbestos. The landfill materials are currently covered by a sand and vegetated soil layer ranging in depth from 1 to 3 feet. Approximately 2.5 acres of the site is used as a skeet shooting range.

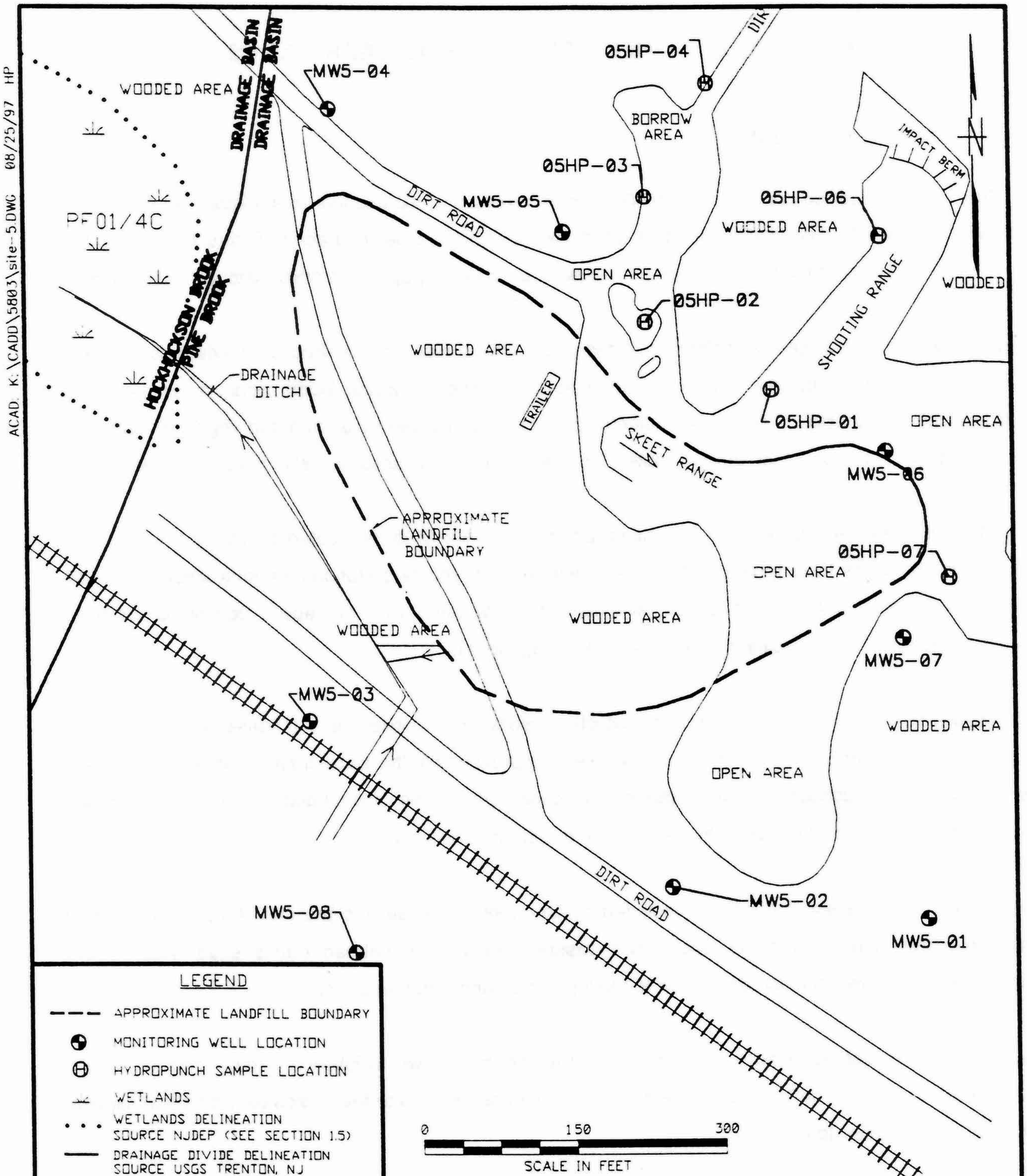
As shown on Figure 4-1 a trap/skeet shooting facility (Shooters Club) is located on top of the landfill at Site 5. The Shooters Club consists of concrete walkways to shooting stations, various small structures which house target throwing equipment, wooden light standards with the associated lights for night shooting, and other small ancillary items (gun racks, flagpole, etc.).

Also included at the facility is a clubhouse which consists of a mobile home ("Trailer" on Figure 4-1), approximately 60 feet by 12 feet and a wooden deck approximately the same size. Two large vaults are installed within the clubhouse and are used to store guns, ammunition, and related equipment used during shooting events. The clubhouse includes a sink and restroom facilities.

Electric service to the shooters club is provided by an underground electric line (100 Amp, single phase) which was trenched through the landfill and passes beneath the railroad tracks south west of the clubhouse. Underground electric lines run to the light poles and range equipment.

The clubhouse is also serviced by an underground telephone line which follow the main road into Site 5 (from the north west). The telephone line from the clubhouse extends to the explosive ordinance disposal (EOD) bunker, located to the north.

Potable water is supplied to the clubhouse by 5-gallon carboys from a local bottled water supplier. Water for non-potable uses is also available via a portable tank ('Water Buffalo") located adjacent to the clubhouse.



DRAWN BY HJP	DATE 08/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	SITE 5—LANDFILL WEST OF ARMY BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-1	REV. 0

The clubhouse includes its own heating system, which is fired by propane. A propane storage tank is located adjacent to the clubhouse.

Wastewater from the clubhouse is treated by an existing on-lot septic system consisting of a septic tank and leach field.

A gravel parking area is located adjacent ot the clubhouse. Gravel and dirt roads are located within the landfill boundary, including the road to the trap/skeet range which turns and continues to the EOD bunker, and an access road crossing the landfill from the northwest to southeast .

Wetlands are located to the southwest of the landfill. No wetlands are located within the landfill.

Site 5 is located within the safety distance arc for the EOD range. When work is being performed at the EOD range (approximately 1,250 feet to the north), Site 5 must be vacated.

4.2 GEOLOGY

Regional mapping places Site 5 within the outcrop area of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The lithology of the soils encountered in the on-site borings (from previous remedial investigations) generally agrees with the published descriptions of the Kirkwood and Vincentown Formations. The on-site borings were no greater than 55 feet deep. Assuming a portion of the Kirkwood Formation was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Vincentown Formation. In general, the borings encountered brown and gray, very fine- to medium-grained sand and dark-colored silt (probably representative of the Kirkwood Formation) and olive and olive brown, slightly glauconitic, fine- to coarse-grained sand (probably representative of the Vincentown Formation). The Mainside area is located above the updip limit of the Piney Point, Shark River, and Manasquan Formations; therefore, the glauconitic sand is interpreted to be part of the Vincentown Formation.

4.3 SOILS

The soils covering Site 5 belong to 4 different series. The series include the Atsion, Keyport, Lakehurst, and Lakewood (USDA, 1989). Each series and the appropriate mapping unit that covers Site 5 are described in detail below.

Boring logs, completed during remedial investigation activities at the site, indicate that the surface and shallow subsurface soil is comprised of silty, fine-grained sand with some clay. The soil's consistency ranges from very loose to medium dense. The color of the surface and shallow subsurface soil varies between boring locations. Some soil is orange-brown to gray-brown in color, while others are dark brown to olive-brown.

Atsion series soils, mapped as Atsion sand, are nearly level, poorly drained soil in depressional areas and on broad flats. These soils formed in acid, sandy, Coastal Plain sediments. A minor portion of Site 5 is mapped as Atsion sand. Permeability of the sand is moderately rapid or rapid in the subsoil and rapid in the substratum. The available water capacity is low. Runoff is very slow and erosion is a slight hazard. Most of the areas of this soil are wooded. Common species of trees include pitch pine, black gum, and red maple. The surface layer of the Atsion series is approximately 8 inches thick. The layer contains 2 inches of partly decomposed organic material and roots and 6 inches of black sand. The subsurface soil is grayish brown sand 14 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 5.

The Keyport series consists of moderately well drained soils on uplands. These soils formed in acid, clayey, Coastal Plain sediments. The mapping unit identified within the Keyport series at Site 5 is the Keyport sandy loam, 2 to 5 percent slopes (USDA, 1989). This unit covers a western portion of Site 5. It is a gently sloping, moderately well drained soil on low divides. Permeability of this soil is slow in the subsoil and the substratum. The available water capacity is high and runoff is medium. Erosion is a moderate hazard. The most common species of tree found in Keyport soil include yellow poplar, northern red oak, and American beech. Some areas of Keyport soil have pyritic clay in the substratum. If the clay is exposed during excavation and used as top soil, it will become extremely acid (pH about 2.5-3.0) and will not support vegetation. The surface soil is brown sandy loam 8 inches thick and the subsurface soil is yellowish brown silty clay loam 18 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 5.

The Lakehurst series consists of moderately well drained and somewhat poorly drained soils on uplands. These soils were formed in acid, sandy Coastal Plain sediments. The mapping unit identified within the Lakehurst series at Site 5 is the Lakehurst sand, 0 to 2 percent slopes (USDA, 1989). This unit covers a limited portion of Site 5. It is a nearly level, moderately well drained and somewhat poorly drained soil in depressional areas and on low divides. Permeability of this sand is rapid in the subsoil and the substratum. The available water capacity is low and runoff is very slow. Water erosion hazard is slight, but wind erosion is a severe hazard. Most areas of this soil are woodland. The most common species of tree found in Lakehurst sand is the pitch pine. The surface layer is gray sand 4 inches thick. The subsurface layer is light gray sand 6 inches thick. These soil characteristics generally do not correspond to the soil encountered during boring activities at Site 5.

The Lakewood series consists of excessively drained soils on uplands. These soils were formed in acid, sandy, Coastal Plain sediments. The mapping unit identified within the Lakewood series at Site 5 is the Lakewood sand, 0 to 5 percent slopes (USDA, 1989). This unit covers a majority of Site 5. It is a nearly level and gently sloping, excessively drained soil on divides. Permeability of this sand is rapid in the subsoil and moderate to rapid in the substratum. The available water capacity is low and runoff is very slow. Water erosion hazard is slight, but wind erosion is a severe hazard. Common species of trees found in Lakewood sand include pitch pine, shortleaf pine, chestnut oak, black oak, and Virginia pine. The surface layer is 4 inches thick. The uppermost inch is dark brown, matted decomposed organic material, and below that it is dark grayish brown sand. The subsurface soil of the Lakewood series is light brownish gray sand 10 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 5.

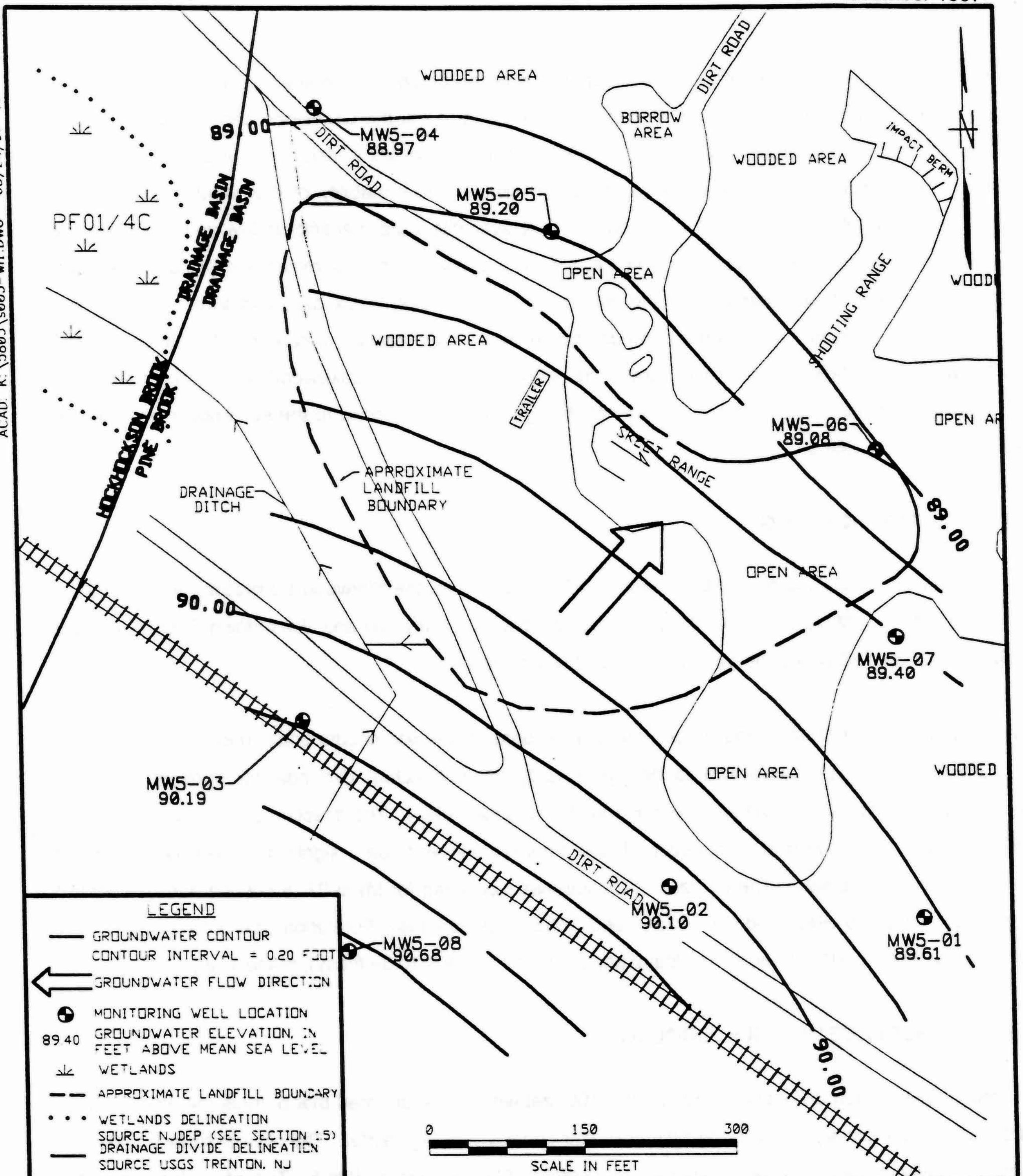
4.4 HYDROGEOLOGY

Based upon the boring log descriptions, well MW5-06 penetrated the Kirkwood Formation, wells MW5-02, MW5-03, MW5-05, MW5-07, and MW5-08 penetrated both the Kirkwood and Vincentown Formations, and wells MW5-01 and MW5-4 penetrated the Vincentown Formation.

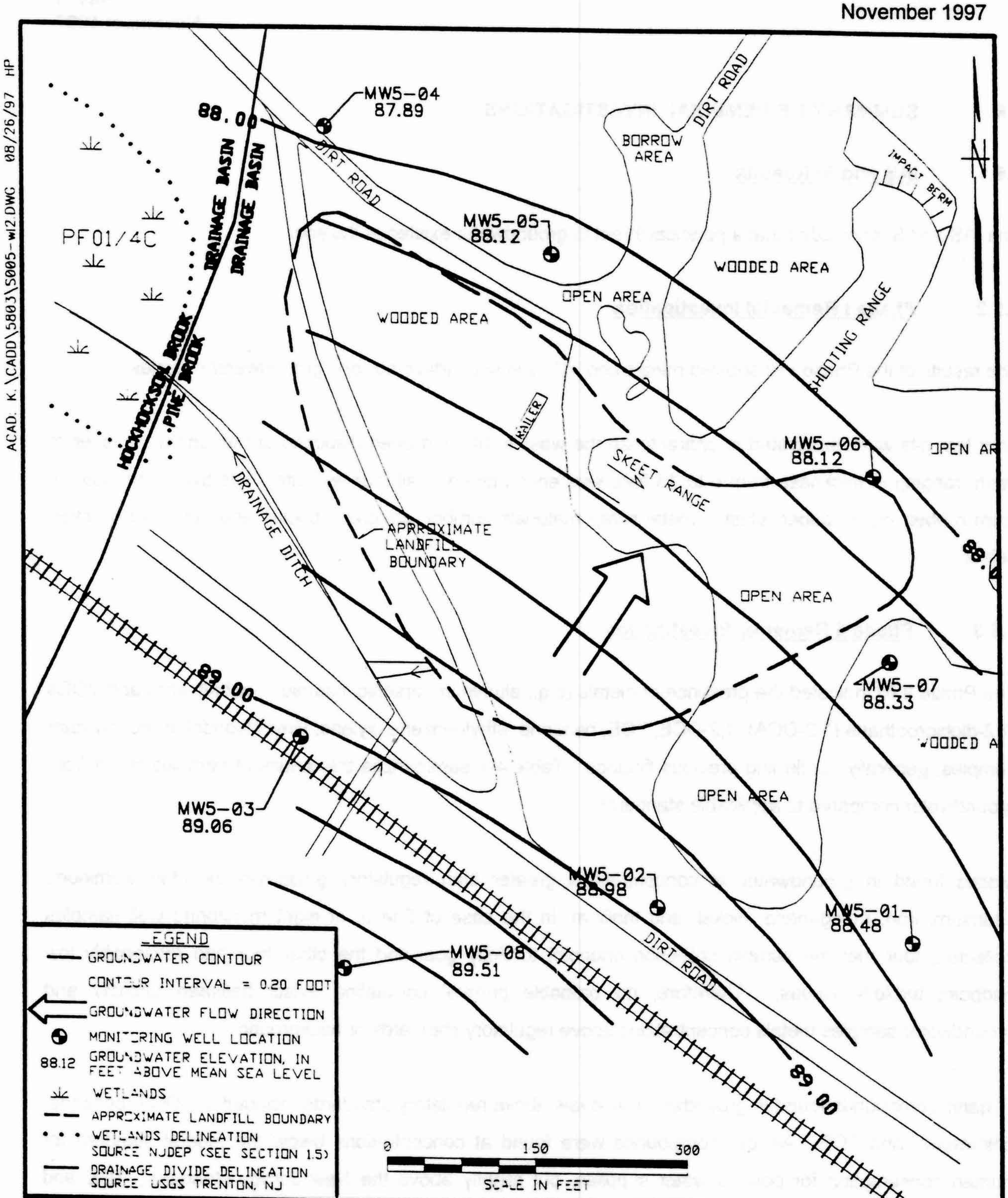
Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Groundwater contour maps are presented in Figure 4-2 (August 1995) and Figure 4-3 (October 1995). The direction of shallow groundwater flow in the aquifer is toward the northeast. There does not appear to be a significant seasonal variation in groundwater flow direction. The hydraulic conductivities calculated for MW5-02 (Kirkwood and Vincentown Formation), MW5-06 (Kirkwood Formation), and MW5-07 (Vincentown Formation) are 3.18×10^{-4} cm/sec (0.90 ft/day), 6.46×10^{-4} cm/sec (1.83 ft/day), and 2.08×10^{-4} cm/sec (0.59 ft/day), respectively.

4.5 SURFACE WATER HYDROLOGY

A small drainage ditch is located approximately 100 feet west of the dirt road that borders the western edge of the site, and water is present in the ditch only after periods of heavy rainfall. The closest surface water is a tributary of Hockhockson Brook, located approximately 1,000 feet east of Site 5. The site is located on the border of the Hockhockson Brook and Pine Brook watersheds. The topography of the site is flat, inhibiting off-site runoff; therefore, precipitation perches and infiltrates on the site. No surface seeps exist at the landfill.



DRAWN BY HJP DATE 08/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY DATE	GROUNDWATER CONTOUR MAP AUGUST 7, 1995 SITE 5 LANDFILL WEST OF ARMY BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 4-2	REV. 0



DRAWN BY HJP	DATE 08/26/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	GROUNDWATER CONTOUR MAP OCTOBER 17, 1995 SITE 5 - LANDFILL WEST OF ARMY BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-3	REV. 0

4.6 SUMMARY OF REMEDIAL INVESTIGATIONS

4.6.1 IAS and SI Results

The IAS and SI concluded that a potential threat to groundwater existed at the site.

4.6.2 Phase I Remedial Investigation

The results of the Phase I RI showed metals and VOCs in subsurface soil and groundwater samples.

Four test pits were excavated to characterize the wastes that had been disposed at the landfill. A layer of trash, ranging in thickness from 6 to 13 feet, was encountered in all four test pits. The trash consisted of foam rubber, glass, paper, plastic, metal scrap materials, lumber, concrete, bricks, and other construction debris.

4.6.3 Phase II Remedial Investigation

The Phase II RI indicated the presence of metals (e.g., aluminum, arsenic, cadmium, cobalt, iron) and VOCs [1,2-dichloroethane (1,2-DCA), 1,2-DCE, TCE, benzene, ethylbenzene, xylene, vinyl chloride] in groundwater samples, generally confirming previous findings. Table 4-1 summarizes the results of samples taken from groundwater compared to applicable standards.

Metals found in groundwater at concentrations greater than regulatory guidelines included aluminum, cadmium, iron, manganese, nickel, and thallium. In the case of Site 5, of eight monitoring well samples collected, four met the sample collection endpoint turbidity goal and the other four had reasonably low endpoint turbidity values. Therefore, no probable general correlation exists between turbidity and groundwater samples metals concentrations above regulatory standards or background.

Organic compounds found in groundwater at levels above regulatory standards included 1,2-DCA, benzene, chloroform, and TCE. All four compounds were found at concentrations below the federal standard for human consumption for potable water supplies, but slightly above the New Jersey standard. TCE and benzene were each found in two monitoring wells downgradient of the landfill. Chloroform was found in one monitoring well upgradient of the landfill at a concentration above the New Jersey standard.

TABLE 4-1

SITE 5 GROUNDWATER
NWS EARLE, COLTS NECK , NEW JERSEY

	Maximum Exceedance	Frequency of Eceedance	ARARs and TBCs			Data Exceeding ARARs					
			Maximum Contaminant Level (MCL) (ug/L)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard (ug/L)	05GW01 1995 RI 7/21/95	05GW02 1995 RI 7/07/95	05GW04 1995 RI 7/21/95	05GW05 1995 RI 7/5/95	05GW06 1995 RI 7/13/95	05GW07 1995 RI 8/22/95
Aluminum	42000	8/8	-	-	200	2150 J	4310	7870 J	2740	2600	497
Cadmium	8	2/8	5	5e	4					7	
Iron	59200	8/8	-	-	300	2670	453	1450 J	2310	59200J	331
Manganese	302	4/8	-	-	50		65		171	156	
Nickel	102	1/8	100	100a	100						
Thallium	6	3/8	2	0.4a	10	4	5		6 J		
1,2-dichloroethane	3	1/8	5	700e	2					3 J	
Benzene	3	2/8	5	200d	1					2 J	
Chloroform	22	1/8	100	100e	6	22					
Trichloroethene	4	2/8	5	-	1		3		55	4 J	

J = Value is estimated because the concentration is below the laboratory contract quantitation limit or because of data validation control quality criteria.
a = The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.
d = The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.
e = The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

4.6.4 Groundwater Modeling

Computer modeling estimated that Site 5 groundwater metal concentrations would gradually diminish over a long period of time, assuming a source control measure, such as capping, would be implemented to control vertical migration. The model estimated that metals concentrations at the nearest potential discharge point, a stream located approximately 3,500 feet downgradient of Site 5, would be well below either the state standard or background levels. Surface water samples taken from the watershed downgradient of Site 5 currently show no concentrations of compounds above background or regulatory standards.

4.6.5 Summary

In summary, results of investigations at Site 5 indicate that:

- Metals concentrations in groundwater were found to be slightly higher than background or the corresponding New Jersey standard (generally at 1 or 1.5 times the corresponding background concentration).
- Modeling estimates that metals in groundwater will migrate only very little, and concentrations will diminish slowly with time
- Thallium found at low concentrations in groundwater upgradient of the landfill does not appear to be leaching from the landfill.
- Source control (e.g., covering the landfill) would inhibit infiltration of water through the landfill, preclude the leaching of additional metals and volatiles, and promote natural attenuation. Long-term monitoring would be required to evaluate the effectiveness of source control.
- The low levels of 1,2-DCA and TCE found in groundwater downgradient of the landfill are indicative of contaminants leaching from a limited source area that are degrading with time and are not widely spread.
- The low level of chloroform found in one upgradient monitoring well does not appear to be the result of a concentrated source in the area of the landfill.

After significant investigation over more than a decade, no concentrated source of VOCs has been found at Site 5. It is unlikely that a concentrated source of VOC contamination exists in the landfill material.

5.0 PRE-DESIGN INVESTIGATION

5.1 PRE-DESIGN INVESTIGATION ACTIVITIES

A pre-design investigation was completed to gather information required for the design effort. The pre-design investigation included the following components:

- Geotechnical Investigation
- Test Pit Investigation
- Wetlands Delineation
- Topographic Survey

A general description of the scope of work activities is provided in Sections 5.1.1 through 5.1.4. The results of the pre-design investigation at Sites 4 and 5 are included in Sections 5.2 and 5.3, respectively.

5.1.1 Geotechnical Investigation

Geotechnical investigations were performed at Sites 4 and 5 to verify the soil geotechnical characteristics and the depth of waste. The results of this investigation were used to estimate the stability of the regraded landfill and cover system as well as estimate landfill settlement due to the additional load of the cover materials.

A total of 8 geotechnical soil borings were completed at Sites 4 and 5. The borings were drilled using hollow stem auger techniques. The hollow stem augers had a minimum inside diameter of 4 inches.

Soil samples were collected continuously at each boring location using two-inch diameter split spoons samplers. Each split-spoon sampler was driven to the required depth with a rig-mounted hammer weighing 140 pounds and falling 30 inches. All samples obtained from the boreholes were screened with a photoionization detector (PID) immediately upon opening and the associated readings were recorded on the boring logs. Soil characteristics and geotechnical information from each split-spoon sample were also recorded on the boring logs.

At least one soil sample was selected from each soil boring location for geotechnical testing. Each soil sample was analyzed for soil classification (ASTM Method D 2488), particle size (ASTM Method D 422), moisture content (ASTM Method D 2216), and Atterburg Limits (ASTM Method D 4318).

Additional soil samples were collected when more than one stratigraphic layer was observed within a split spoon sample. The soil samples were placed into individual clear plastic bags following sample retrieval and field (visual) classification, and the bags sealed to reduce moisture loss. All soil samples were maintained on site until the appropriate samples were selected for laboratory testing. Soil samples that were not shipped from the site for laboratory testing were disposed of at the respective site.

The original work scope for the geotechnical testing included collection of one sample of fine grained soils from each site using a Shelby tube sampler These samples would be analyzed for triaxial compression testing (ASTM Method D 4767) and consolidation (ASTM D 2435). Since no fine grained cohesive material was encountered in any of the soil borings, neither triaxial compression or consolidation testing was performed.

Upon completion of each boring, the individual borings were backfilled with cement/bentonite (6 to 1 ratio, respectively) grout through the center of the augers with a tremie tube. Each boring was grouted from the bottom of the boring to the ground surface.

5.1.2 Test Pit Investigation

The limits of waste at Sites 4 and 5 were initially determined through examination of historical records and aerial photography (Figures 3-1 and 4-1). Test pit investigations were later performed at Sites 4 and 5 to confirm the actual limits of the waste.

Test pits were excavated along the boundary of each site to determine the limits of the disposal areas. All test pits were excavated using a rubber tire backhoe. The test pits were generally excavated perpendicular to the landfill boundary until the limit of landfilled material was encountered and visually identified. Logs were completed for each test pit and included the test pit number, location, and materials encountered.

Test pits were backfilled immediately after completion. Test pits were backfilled with the excavated material from the associated test pit.

5.1.3 Wetlands Delineation

Potential wetlands areas at Sites 4 and 5 were originally delineated using maps generated by the NJDEP which were based on aerial photography. During the pre-design activities, potential wetland areas at each site were field delineated to provide a more accurate determination of wetlands areas. The field delineation was performed by a certified wetlands specialist.

Wetland delineations at each site were performed in accordance with procedures outlined in the U.S. Army Corps of Engineers Wetland Delineation Manual (1987). All delineations included an onsite inspection of the vegetation, soils, and hydrogeology.

5.1.4 Topographic Survey

Topographic surveys were performed at each site to map the existing site topography and provide a basis for cut/fill calculations for cap installation. The topographic surveys were performed by a New Jersey licensed Land Surveyor.

The topographic maps were prepared on a scale of 1 inch = 50 feet and 1-foot contour interval. Planimetric features such as streams, pipes, roads, etc. were included for clarity.

5.2 PRE-DESIGN INVESTIGATION - SITE 4

5.2.1 Geotechnical Investigation

The geotechnical investigation at Site 4 was performed on June 17 and 18, 1997 and included completion of 3 geotechnical borings at locations indicated on Figure 5-1. A total of 5 geotechnical borings were originally planned for Site 4, but only 3 could be completed due to access problems. Five monitoring wells surround Site 4. The boring logs from the installation of the monitoring wells were also used in analyzing the subsurface conditions.

Boring logs for the 3 geotechnical borings are included in Appendix A. Appendix B includes boring and well installation logs which were completed during previous remedial investigations and are provided here for information purposes.

A total of 4 samples were submitted to Valley Forge Laboratories, Inc. for geotechnical analysis. Laboratory results of these samples are included in Appendix C. The laboratory results described the soil samples as non-plastic tan, poorly-graded sand with silt (SP-SM). Natural moisture contents ranged from 5.4 to 14.1 percent. Laboratory testing was performed using personal protective equipment (PPE) Level D.

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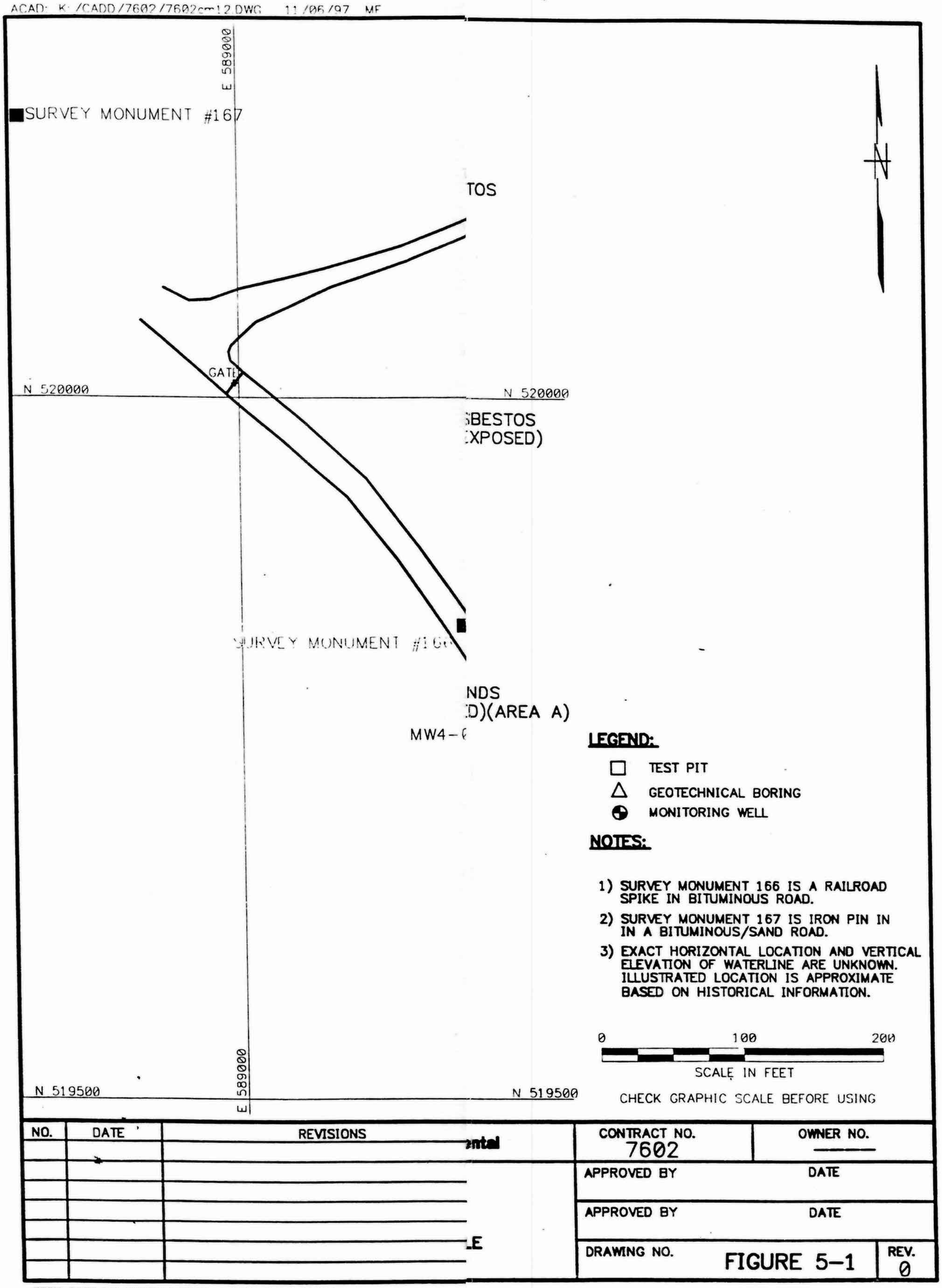
ACAD: K:/CADD/7602/7602cm12.DWG 11/06/97 MF
E 589000
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GATE
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BESTOS
XPOSED)
SURVEY MONUMENT #166
NDS
D)(AREA A)
MW4-
LEGEND:
TEST PIT
GEOTECHNICAL BORING
MONITORING WELL
NOTES:
1) SURVEY MONUMENT 166 IS A RAILROAD SPIKE IN BITUMINOUS ROAD.
2) SURVEY MONUMENT 167 IS IRON PIN IN IN A BITUMINOUS/SAND ROAD.
3) EXACT HORIZONTAL LOCATION AND VERTICAL ELEVATION OF WATERLINE ARE UNKNOWN. ILLUSTRATED LOCATION IS APPROXIMATE BASED ON HISTORICAL INFORMATION.
0 100 200
SCALE IN FEET
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FIGURE 5-1
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None of the three geotechnical borings were completed within the boundary of the landfill at Site 4 (Figure 5-1). Access problems restricted placement of borings. The results of the test pit investigation (Section 5.2.2) determined that the boundary of the landfill was somewhat different than was originally estimated. The test pit investigation for Site 4, which was completed after the geotechnical boring program was completed, determined that the western boundary of the landfill was further east than what was originally estimated.

5.2.2 Test Pit Investigation

The test pit investigation for Site 4 was completed on June 17, 18, and 19, 1997 and included excavation of a total of 24 test pits at Site 4. The locations of these test pits are included on Figure 5-1. The logs for each test pit are included in Appendix D.

The limits of the Site 4 landfill area along the southern edge were not delineated with test pits due to access problems with the backhoe. Therefore, the southern limit of the landfill was determined through a combination of visual observations, the results of other test pit work around Site 4, and interviews with NWS personnel who were knowledgeable about past landfill operations at both Sites 4 and 5.

After Site 4 was closed, the disturbed areas of the landfill were revegetated with pine trees. These pine trees were generally planted in rows and were much smaller than the surrounding woodland vegetation, which was generally composed of a combination of pines and hardwood trees. During the test pit investigation, this difference in tree growth across the site was used to determine the approximate boundary of the landfill and focus the test pit investigation.

Visual observations were also used to determine the limit of waste for the landfill. Along the eastern and southeastern edge of the landfill, waste materials were exposed in a "face" which extended as much as 10 to 15 feet above surrounding grade. Several test pits were excavated to the east and southeast of this "face" (access permitting) to confirm that no waste materials extended past the visible "face."

The southwest boundary of the landfill is bounded by a topographic ridge which extends approximately 20 feet above surrounding grade and is vegetated with older tree growth. A drainage ditch forms the boundary between the southwest edge of the landfill and this ridge. Test pit excavations and visual observations confirmed that the limit of waste extended to the northern edge of this drainage ditch. The south side of the ditch appeared to be undisturbed and was vegetated with larger hardwood trees and laurel. The bottom of the drainage ditch was assumed to be the limit of waste material along the southern side of Site 4.

A mix of waste materials was encountered in the test pits within the former landfill boundaries and was composed mainly of municipal/industrial waste materials. Ordnance-type materials were encountered at 04-TP-02 and consisted of various components such as shipping containers, detonator batteries, etc..

5.2.3 Wetlands Delineation

A total of three suspected wetlands areas were identified in the immediate area of Site 4 which could be impacted by site-related activities. These areas were identified as:

- Area A - Near the southeast corner of the landfill boundary
- Area B - South of Area A
- Area C - Within the landfill boundary

The locations of these areas are included on Figure 5-1. Of the three potential wetlands areas studied, Area A and Area B were the only areas which were confirmed as wetlands. Area C did not meet all of the requirements of a wetland. Area A is located near the southeast corner of the landfill and will likely be affected during installation of the cap and related appurtenances. Area B is located further south from Area A and will likely not be affected by construction activities. Appendix E provides additional information on the delineation of each area.

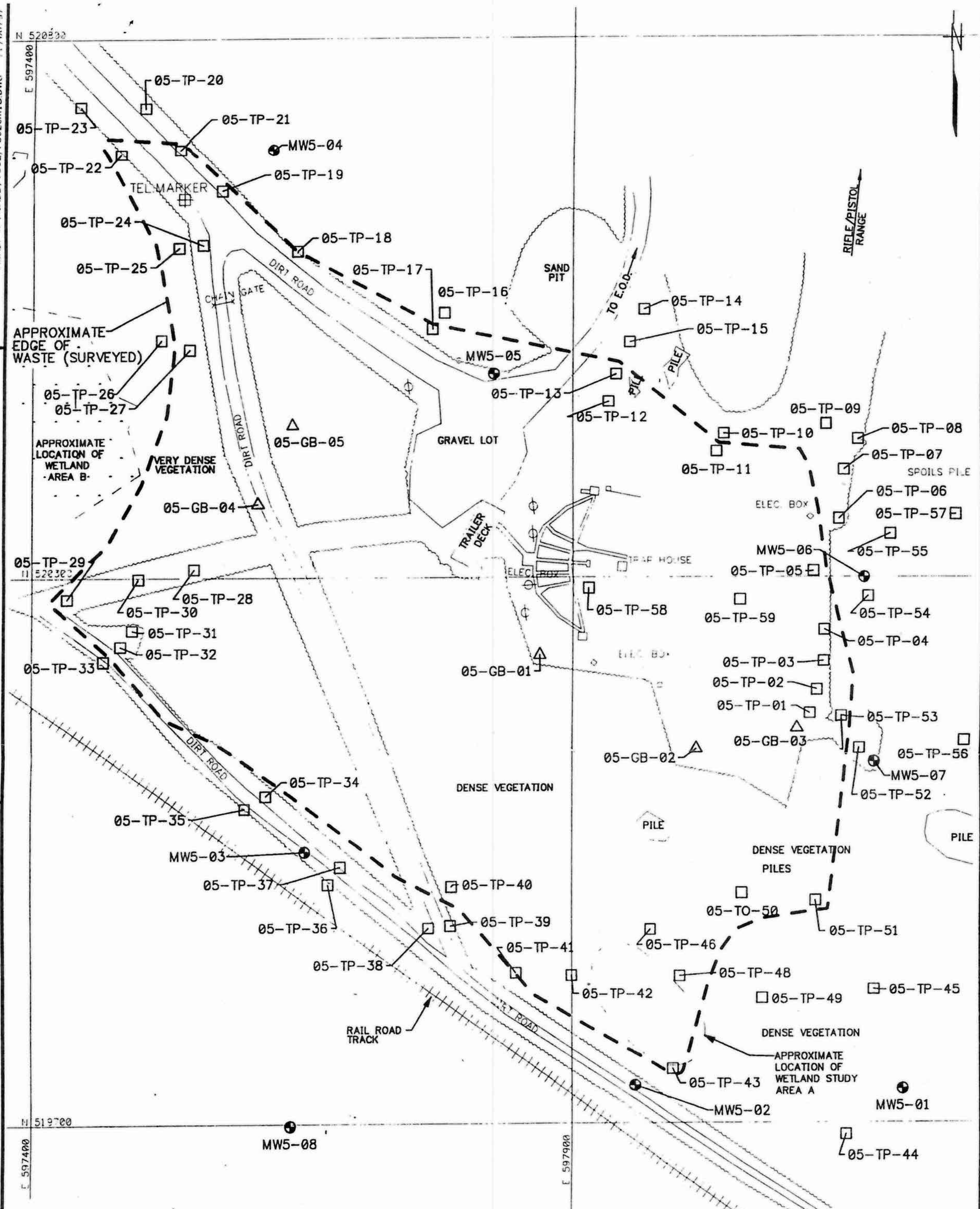
On Friday, October 3, 1997, the Navy and B&R Environmental personnel met with a representative of the NJDEP to review the boundaries for the individual wetlands areas. The boundaries have been revised to reflect the field confirmation by the NJDEP.

5.3 PRE-DESIGN INVESTIGATION - SITE 5

5.3.1 Geotechnical Investigation

The geotechnical investigation at Site 4 included completion of 5 geotechnical borings at locations indicated on Figure 5-2. Boring logs for the 5 geotechnical borings are included in Appendix F. Appendix G includes boring and well installation logs which were completed during previous remedial investigations and are provided here for information purposes.

A total of 4 samples were submitted to Valley Forge Laboratories, Inc. for geotechnical analysis. Laboratory results of these samples is included in Appendix H. The laboratory results described the soil samples as green clayey sand (SC), silty clayey sand (SM-SC), or poorly-graded sand with silt (SP-SM).



LEGEND:

- □ TEST PIT
- △ GEOTECHNICAL BORING
- ⊕ MONITORING WELL

NOTES:

1) SITE 5 SURVEY MONUMENTS ARE LOCATED OUTSIDE THE BOUNDARIES PRESENTED ON THIS FIGURE.

0 100 200

SCALE IN FEET

CHECK GRAPHIC SCALE BEFORE USING

DRAWN BY TAD	DATE 8/28/97	Brown & Root Environmental	CONTRACT NO. 7602 / OWNER NO. 0289
CHECKED BY	DATE	SITE 5 PRE-DESIGN EXISTING CONDITIONS PLAN NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY / DATE
COST/SCHED-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 5-2 / REV. 0

FORM CADD NO. SOUTH_BV.DWG - REV 0 - 04/16/97

Natural moisture contents ranged from 9 to 22.6 percent. Due to the presence of significant odors, laboratory testing of Site 5 soil samples was performed using personal protective equipment (PPE) Level C.

5.3.2 Test Pit Investigation

A total of 59 test pits were excavated to delineate the approximate limits of fill areas at Site 5. The locations of these test pits are included on Figure 5-2. The logs for each test pit are included in Appendix I. It should be noted that Test Pit 47 (05-TP-47) was never excavated and represents a skipped number in the test pit numbering sequence.

A mix of waste materials was encountered in the test pits within the former landfill boundaries and was composed mainly of municipal/industrial waste materials. Ordnance-type materials were encountered at 05-TP-29 and included three empty depth charges.

5.3.3 Wetlands Delineation

A total of three suspected wetlands areas were identified in the immediate area of Site 5 which could be impacted by site-related activities. These areas were identified as:

- Area A - Within the landfill boundary
- Area B - West of the landfill boundary
- Area C - West of Area B

The locations of these areas are included on Figure 5-2. Of the three potential wetlands areas studied, only Area B and Area C were confirmed as wetlands. These two wetlands are located to the west of the landfill boundary. Area B appears to be the only wetland which could potentially be affected by site remedial activities.

Area A (not identified as a wetland) is a small depression located near the south end of the landfill, within the landfill boundary and will likely be affected during installation of the cap and related appurtenances. Appendix E provides additional information on the delineation of each area.

On Friday, October 3, 1997, the Navy and B&R Environmental personnel met with a representative of the NJDEP to review the boundaries for the individual wetlands areas. The boundaries have been revised to reflect the field confirmation by the NJDEP.

The representative of the NJDEP felt that Area A was in fact a wetland, however, since this area lies completely within the boundary of the landfill, this area does not need to be restored or replaced.

6.0 DESIGN REQUIREMENTS

6.1 APPROACH

The proposed caps for Sites 4 and 5 are intended to provide a cover over waste materials disposed of at the respective sites. A brief summary of the approach to each site is provided.

6.1.1 Site 4

As indicated on Figure 5-1, the results of the test pit investigation indicated a somewhat irregular area for waste deposition. The limit of waste extends to the bottom of a relatively steep slope along the south east side of the landfill. At the bottom of the steep slope a wetland (Wetland Area A) has been identified. In order to minimize the surface area of the cap, and to improve the constructability of the landfill, two areas of waste material will be excavated and regraded under the cap. These areas include:

- The narrow area trending in an east-west direction at the southwest corner of the landfill. Based on the test pits which were excavated in this area, most of this area consists of a relatively thin layer of waste (1 to 2 feet) with deeper portions (5-6 feet) toward the main body of the landfill. In calculating the volume of waste to be removed from this area it was conservatively assumed that the waste thickness was a uniform 6 feet thick.

- A smaller protruding area near the southeast corner of the landfill, adjacent to Wetland Area A (Site 4). In order to calculate the volume of this excavation area it was assumed that the waste material does not extend deeper than the existing relatively flat natural grade at the bottom of the slope.

In addition to the areas of excavation, the existing limit of waste will be moved in two places. The regraded waste would be extended from the existing limit of waste to improve the constructability of the cap system on the west side of the landfill and along an indentation in the existing limit of waste along the south east corner. The filling of this indentation will impact a small portion of the wetland, however, the excavation of the waste area adjacent to this indentation will result in an area which could be established as new wetland.

The remainder of the landfill would be graded to establish uniform slopes in preparation for installation of the cap. With respect to the southeast corner of the landfill it was decided to hold the existing limit of waste over most of the slope for the regrading of the waste material. This will result in filling a strip of the wetlands with clean fill to allow for the termination of the cap components. The alternative to this would be to excavate back into the landfill slope to allow for the termination of the cap system outside of the wetlands. It was decided to limit the amount of waste excavation due to the presence of the steep slopes and difficulties that this could cause during construction.

The small protruding area of waste (adjacent to Wetland Area A) will be excavated and this material consolidated under the cap. The excavated area will be regraded, revegetated, and restored as additional wetlands. This additional area of wetlands will offset the area of wetlands lost due to cap installation.

6.1.2 Site 5

As indicated on Figure 5-2, the results of the test pit investigation indicated a somewhat irregular area of waste deposition. The existing topography at Site 5 was relatively flat, requiring excavation of waste materials near the perimeter of the landfill and movement of these materials toward the center of the site to create the required slope while balancing the cut/fill requirements. In some areas, the landfill boundaries are adjacent to hillsides, requiring excavation of wastes from specific areas to allow installation of the cap and related drainage swales along the perimeter.

In addition, the restoration of Site 5 includes the replacement of the trap/skeet range after the site is capped. The location and orientation of the trap/skeet range could not be changed without an extensive review and approval process by the Navy. Site approval from Naval Ordnance Center and Naval Facilities Engineering Command must be obtained based on the redesign of the trap/skeet range.

The surface of the trap/skeet range will be paved on the final cap surface to facilitate the removal of clay pigeons and lead shot. Due to the possibility of either the shot damaging the pavement or having shot ricochet off of the pavement, it was decided to configure the grades on the cap so that the shooting positions are located at a high point in the cap, with the surrounding grade sloping downhill from the shooting positions. To accommodate this design constraint, the high point of the landfill cap was placed as close as possible to the shooting positions while minimizing the amount of cut and fill.

6.2 MATERIAL/SOILS MANAGEMENT

Based on the results of soil analysis, test pit investigation, and the site survey performed during the pre-design investigation, the volumes of waste materials to be excavated and filled at each site were estimated. The estimates are based on the regrade surface and do not include imported materials for the cap components. The estimated volumes are as follows:

Location	Waste Volume To Be Excavated (CY)	Volume To Be Filled (CY)	Net Difference
Site 4	7,384	7,408	24 excess fill
Site 5	12,858	14,157	1299 excess fill
TOTAL	20,242	21,565	1323 excess fill

Cut/fill balances and excavated soil volumes reported for these designs are determined by a computer modeling software by forming Triangulated Irregular Networks or TINs between several 3-dimensional points located on each of the respective surfaces. Cut/fill balances and excavated volumes between to particular surfaces are thence calculated by summing the volumes calculated for tetrahedrons formed from adjacent triangles in the TIN. This method is considered to be more accurate than cross section, average end area, or grid methods.

6.3 COVER SYSTEM LIMITS

The proposed cover system is intended to cover the area at Sites 4 and 5 as delineated by the test pit investigation. The original limits of the waste material have been modified as described above. The final limits of waste will be covered by the cap system. The limits of the cap at each site have been established to minimize infiltration through subsurface soils, as well as to provide a vertical soil buffer between the waste and potential receptors.

The proposed landfill caps for Sites 4 and 5 will have footprints as shown on the design drawings. For Site 4, the cap footprint will occupy an area of 2.7 acres. The cap will maintain a minimum 4.0 percent slope to promote runoff of precipitation. The cap high point will have an elevation of 183 feet msl.

For Site 5, the cap footprint will occupy an area of 7.9 acres. The impermeable layer of the cap will maintain a minimum 3.5 percent slope to minimize hydraulic head on the cap. The final grade of the cap in the skeet range was adjusted to a flatter scope to provide a flat area for the skeet range shooting positions. This flat area was created by increasing the thickness of the select fill in the cover system. This allowed the low permeability layer to maintain a 3.5 percent slope and the final surface to be flatter. The cap high point will have an elevation of 120 feet msl. The proposed cap minimizes the capacity while maintaining the necessary footprint over the waste disposal areas.

6.4 FINAL COVER SYSTEM DESIGN

The proposed cap system for each landfill complies with the Resource Conservation and Recovery Act (RCRA) Subtitle D requirements as well as NJDEP requirements for closure of municipal landfills. The caps for each site will have similar configuration and will include the following components, in ascending order:

- A 12-inch-thick bedding/landfill gas management layer
- 40 mil very flexible polyethylene (VFPE) geomembrane
- Cushion fabric
- A 12-inch-thick layer of granular drainage material
- A nonwoven geotextile (filter)
- A 12-inch-thick select fill material (part of the vegetative layer)
- A 6-inch-thick topsoil layer (part of the vegetative layer)

VFPE is a generic term used by several manufacturers and researchers to describe a class of resins used to make geomembranes including LDPE (low density polyethylene), VLDPE (very low density polyethylene), and LLDPE (linear low density polyethylene).

6.4.1 Bedding/Gas Management Layer

The bedding/landfill gas management layer is included in the cap section to provide a suitable base on which to construct the other layers of the cap. The New Jersey regulations (NJAC 7:26-2A) require that a minimum of 6 inches of bedding (or a geotextile) be provided above and below the geomembrane layer . The bedding/landfill gas management layer will also serve as a gas management layer to collect gases which may be generated by the landfill and to direct the landfill gas to passive gas vents. A one foot thick layer was chosen to provide additional protection of the geomembrane and to provide adequate cover of the gas management piping.

6.4.2 VFPE Geomembrane/Cushion Fabric

Natural low permeability soils (compacted clay liner), geomembrane, and geosynthetic clay liners (GCL) were evaluated for use as the low permeability layer in the cap system. Due to the generally sandy soils in and around NWS Earle it was felt that a compacted clay liner would not be cost effective since a source of this material could be difficult to locate close to the station. In addition, a geomembrane or a GCL would be easier to construct that a compacted clay liner.

A geomembrane was chosen as the low permeability layer in the landfill caps at Sites 4 and 5 for NWS Earle over a Geosynthetic Clay Liner (GCL) following the evaluation of several design issues associated with GCLS including the following:

- Slope stability
- Differential settlement
- Thinning of the bentonite layer
- Installed cost

Any one of the above issues could be resolved through design modifications, increased cost, or by a willingness to accept a greater possibility of compromise of the low permeability layer, however, taken together it was felt that a geomembrane was a more suitable material in the landfill cap. Each of these issues is discussed in greater detail below.

Slope Stability

The interface between the GCL and the materials placed next to the GCL is a potential failure surface. The proposed cap configuration includes a cushion fabric placed on top of the GCL. The cushion fabric would be needed to protect the GCL from the granular drainage material. Preliminary calculations indicate that this interface will not result in an acceptable factor of safety. The need for the cushion fabric is described below regarding thinning of the GCL.

The cushion fabric would be a heavy non-woven geotextile. The cushion fabric helps protect the geomembrane from puncture from the overlying materials. Generally conservative literature values of interface friction angles are used in the initial slope stability analysis, then site specific tests are performed prior to construction with the actual materials to be used to confirm that the actually friction angles meet the design requirements. Literature values for friction angles between geotextiles are very limited. A value of 18° was obtained between two non-woven geotextiles from Trevira literature. CETCO Literature (manufacturers of Bentomat and Claymax products) lists an interface friction angle between the non-woven side of a bentomat GCL with a woven geotextile to be 12^0. Higher friction angles generally exist with non-woven versus woven geotextiles, so it is assumed that the non-woven side of the GCL would be placed against the cushion fabric. This interface would essentially be a non-woven geotextile to a non-woven geotextile interface.

A simplified infinite slope stability calculation gives a factor of safety against sliding of the cap components with the following equation:

FS = tan friction angle/ tan slope angle

This simplified equation does not account for pore water pressure on the geomembrane or GCL which would lower the factor of safety. A more detailed equation incorporating the pore water pressure is used in the final design calculations.

Based on the above equation, a 4:1 (horizontal to vertical) slope, and a 18° interface friction angle, the factor of safely against sliding is approximately 1.3. A factor of safety of 1.5 is generally considered acceptable for slope stability. This interface was judged to be unacceptable.

Differential Settlement

Landfill caps can be subjected to differential settlement caused by the decay and collapse of materials within the landfill. This has been described as the "rusted refrigerator" scenario (i.e., localized settlement caused by the collapse of refrigerator or similar material disposed of within the landfill). Based on research it appears that GCLs can withstand large distortions and tensile strain up to 10-15 % with out undergoing significant increases in hydraulic conductivity. However, if differential settlement occurs directly beneath a GCL seam (GCLs are seamed by overlapping the GCL and adding granular bentonite along the overlap) the amount of differential settlement the at the GCL can accommodate is limited by the amount of overlap. VFPE geomembrane have very good multiaxial strain characteristics which are superior to GCLs. Given this information it was felt that a VFPE geomembrane provides superior properties with respect to differential settlement as compared to the GCL.

Thinning of the GCL

The possibility exists for bentonite to thin in the GCL due to various loadings causing an increase in permeability of the GCL. The thinning can be caused by the subgrade or cover soil conditions.

The CETCO installation guidelines indicate that the subgrade should possess a particle size distribution such that at least 80 percent of the soil is finer than a #60 sieve (0.25 mm). The current cap design includes a sand bedding/gas management layer, however, it was felt that it would be difficult to locate a local supply of material which meets the GCL requirements and also provide adequate permeability for gas flow.

Finally, the CETCO installation guidelines suggest using only cover soils with a particle size ranging from fines to 1 inch diameter. Soils with minimal fines or a high concentration of aggregate larger than 1 inch should be assessed with a field scale test. The drainage layer to be placed above the low permeability layer would include minimal fines (D2 > 0.1 inch) based on New Jersey sanitary landfill regulations To avoid a very narrow gradation (which may be costly) but also to avoid large stones which could damage the GCL or geomembrane, the drainage material would be limited to 1 inch diameter. To protect the GCL from the granular drainage material it was decided to included a cushion fabric in the design. It was felt that a cushion fabric was also appropriate to protect a geomembrane.

Installed Cost

Vendors were contacted to estimate the installed cost of the low permeability layer in the cap systems. The following table summarizes the costs.

Material	Installed Cost (dollars/square foot)
GCL (non-woven /woven geotextiles)	$0.43-0.52 / sf
GCL (non-woven /non-woven geotextiles)	$0.48-0.57 / sf
40 mil smooth VFPE	$0.35-0.39 / sf
40 mil textured VFPE	$0.38-0.45 / sf

The geomembrane generally has a lower installed cost than the GCL.

Sites 4 and 5 are relatively remote and are located at least partly within explosive safety arcs, it was assumed that future development work at each site would be minimal. In addition, the waste materials at each site appear to be relatively stable, with little evidence of differential settlement. Therefore, long-term maintenance activities associated with the individual caps are assumed to be minimal.

Based on the potential disadvantages of both a GCL and a compacted clay liner, the geomembrane liner was chosen to be used in the cap systems. The N.J.A.C. 7:26-2A.7 requires a minimum 30 mil geomembrane to be used in a landfill cap. A 40 mil geomembrane was chosen because of its enhanced survivability during placement. An VFPE membrane was chosen because of its ability to withstand differential settlement compared to high density polyethylene (HDPE) material.

6.4.3 Granular Drainage Material

A granular drainage layer is placed above the cushion fabric protecting the geomembrane. The function of the drainage layer is to reduce the head which will develop on the geomembrane due to water infiltrating into the cap system. The New Jersey regulations require a 12-inch thick drainage layer above a geomembrane in a landfill cap. Based on the New Jersey sanitary landfill regulations, the drainage material must meet the following gradation:

$$D2 > 0.1 \text{ inch } (2.54 \text{ mm})$$
$$D85 > 4\ D15$$

Material meeting this gradation requirement would correspond to a clean graded aggregate.

6.4.4 Geotextile Filter/Vegetative Layer

Above the drainage layer a non-woven geotextile is included to separate the vegetative layer from the drainage layer. This will prevent the vegetative layer from clogging the drainage layer. The geotextile design is based on that anticipated cover material grain size, the required apparent opening size (AOS), and the permittivity of the geotextile. Above the drainage layer the vegetative layer consists of 12 inches of select fill material covered by 6 inches of topsoil. The select fill material will be materials similar existing soil at the sites such as silty sands. The Rutgers University Agricultural Extension and the USDA Natural Resources Conservation Service were contacted to determine if the vegetative layers possessed enough thickness to support grasses on the landfill cap (specifically hard fescue). The indication from these agencies was that the thickness of the vegetative support layer is adequate.

6.4.5 Landfill Grade

All of the referenced regulations require grading to promote run-off, to prevent run-on, and to accommodate settling. The state sanitary landfill regulations require that, after allowing for settlement, the top surface of a landfill cap be between 3 percent and 5 percent. To be conservative, a minimum slope of 3.5 percent slope was used as a design parameter to determine the regraded surface of the landfill. This provides for settlement, although the calculations indicate that settlement will be negligible. The New Jersey sanitary landfill regulations state that the maximum side slopes are 3 horizontal to 1 vertical. To be conservative and to ensure a stable cap system, a maximum slope of 4 horizontal to 1 vertical was considered when configuring the final cap surfaces. The proposed design promotes the run-off of precipitation.

Various geotechnical analyses, including slope stability and settlement, were performed to verify the adequacy of the proposed grading scenario. Based upon these analyses, it was concluded that:

- Soil loss from the cap surfaces do not exceed 2.0 tons/acre/year as required by the New Jersey sanitary landfill regulations.

- The proposed components of the cover system possess adequate interface friction to provide acceptable system stability.

- The proposed landfill configuration provides an adequate factor of safety against slope stability failure.

- Anticipated cap settlement will not reduce the minimum cap grade to less than 3.0 percent, as required by the regulations.

The geotechnical analyses are described in greater detail in Section 6.5 of this report.

Cross sections for each landfill cap have been provided on 100-foot intervals for this submittal.

6.5 GEOTECHNICAL ANALYSIS

Detailed geotechnical evaluations, including slope stability and settlement, were performed in conjunction with preparation of the remedial design for Sites 4 and 5. Site stratigraphy was inferred from the results of several test borings that were advanced through and adjacent to each site (performed in conjunction with the remedial design as well as during previous site investigations). The stratigraphy is generally described in Sections 3.0 (Site 4) and Section 4.0 (Site 5) of this report, and test boring logs are included as Appendices. In summary, the uppermost stratigraphic unit at Sites 4 and 5 is comprised primarily of sands. No fine-grained stratigraphic units were encountered during the geotechnical boring program, and therefore no undisturbed "Shelby Tube" samples were collected or analyzed. It was judged that, for the purposes of stability and settlement analyses, extensive geotechnical testing of the sand units was not required, and appropriate engineering properties could be inferred from visual classification and blow counts. Laboratory testing included:

- Soil classification
- Particle size
- Atterberg Limits
- Moisture content

Classification-type testing was used to verify continuity and consistency of the stratigraphic units as determined from visual characterization and blow counts. Results of the geotechnical testing are included in Appendix C and H of this report.

6.5.1 Stability Analysis

Detailed slope stability analyses were performed for both the Site 4 and Site 5 landfills, based upon the input data described above. The PCSTABL5 computer program, a two-dimensional limiting equilibrium slope stability method, was utilized to perform the analyses. Numerous iterations of the analyses were performed to identify the failure surface that would correspond to the lowest factor of safety.

Cross section input geometry for existing conditions was obtained from stratigraphic sections that were developed from the site test borings (these stratigraphic sections are included with the design calculations). The location of the groundwater table was inferred from the results of test borings and water level measurement within on-site monitoring wells. Engineering properties of soils were assigned based upon the laboratory testing described above. Materials to be consolidated within the landfill are anticipated to include waste metals and on-site soils that are excavated as part of the overall site remediation, as well as imported clean borrow materials; corresponding engineering properties of these materials were conservatively estimated based upon past experience.

The final grades of the remediated (closed) landfill were inferred from a site grading plan that was prepared during the earliest stages of closure design. It was anticipated that the closure design configuration (and grades) would change as the design approached completion. Therefore, a "worst case" design condition was utilized for the purposes of the stability analyses, assuming a maximum potential sideslope of 4H : 1V, and a maximum apex of the cap at an elevation of 183 feet msl for Site 4. The maximum apex of the cap at site 5 is and 120 msl. The evaluated section was cut along the portion of the cap with the greatest elevation drop.

The results of the stability analyses indicate that, for the worst case geometric conditions described above, the factor of safety is on the order of 2 for Site 4 and exceeds 2 for Site 5. The resultant factors of safety are judged to be acceptable and applicable to all slopes of less height or steepness. Slope stability calculations are included in Appendix J of this report.

In addition, specific stability calculations were performed to verify that the proposed materials of construction for the cover system will provide adequate interface friction to maintain system stability. An infinite slope analysis was performed for the various critical interfaces between cap materials, using interface friction values from published literature It was concluded that the minimum factor of safety exceeds 1.5 for both sites. Infinite slope stability analyses are also included in Appendix J of this report.

6.5.2 Settlement Analysis

Settlement analyses were performed for the landfills at Sites 4 and 5, based upon stratigraphic cross sections that were similar to those used for the slope stability analyses. The anticipated grades of the cover system were assumed based upon the final design configuration (e.g., the worst-case condition that was assumed for the slope stability analyses was not required for these calculations). Settlement within the sand layers is expected to be elastic, such that settlement would occur concurrently with placement of overlying backfill and the cover system. Therefore, it was judged that elastic settlement will not affect the final design grades of the landfill.

The results of the settlement analyses indicate that the proposed minimum grades are acceptable because, following consolidation settlement, the final grades will exceed the minimum slope requirement of 3.0 percent. Settlement calculations are included in Appendix J of this report.

6.6 EROSION, SEDIMENT, AND STORMWATER MANAGEMENT REQUIREMENTS

6.6.1 Erosion and Sediment Control

An erosion and sediment control plan (E&S Plan) has been prepared for this project and is submitted under separate cover. The plan was prepared in accordance with the State of New Jersey regulations as set forth in the Standards for Soil and Erosion Control in New Jersey 1987. Runoff quality during the remedial action will be addressed via temporary erosion and sediment control devices located around the perimeter of the disturbed area. Refer to the draft E&S Plan for detailed information regarding the planned controls as well as runoff calculations.

6.6.2 Stormwater Management

The final cover of the cap system at Site 4 will include topsoil and a vegetated layer. Because of the poor cover soil now present at Site 4 and relatively poor vegetation, the post construction runoff from the cap area will be less than the pre construction runoff. The pre and post construction runoff calculations for both Sites 4 and 5 are presented in Erosion and Sediment Control Plan submitted under a separate cover. The permanent surface water controls at Site 4 include perimeter ditches to control run-on and runoff from the cap system. The perimeter ditches are design to collect flow from the drainage layer in the cap system.

Because the post-construction runoff from Site 4 is less than the pre-construction runoff, permanent detention basins are not required. Temporary sediment basins will be required during construction.

It should be noted that runoff from the landfill area at Site 4 does not have a positive drainage outlet from the wetlands located at the base of the landfill (the wetlands are a low point with no outlet across the dirt road to the east of the site). Under the post construction conditions this situation is not changed so that water will continue to pond in the wetland area. It was felt that creating a positive drainage across this dirt road could potentially drain the wetland.

The final cover of the cap system at Site 5 will include top soil and grass vegetation. Portions of Site 5 will be paved for the trap/skeet range. The runoff for Site 5 will increase from pre-construction to post-construction conditions due primarily to the pavement installation at the trap/skeet range. Detention basins will be required for Site 5 to control the post-construction runoff to pre-construction levels. Perimeter ditches similar to Site 4 will also be constructed at Site 5 to control run-on and run-off and to collect water from the drainage layer in the cap system.

6.7 TRAP/SKEET RANGE REQUIREMENTS

The existing trap/skeet range will be replaced with a new trap/skeet range with similar location, orientation, and configuration.

6.7.1 Design Requirements

The trap/skeet range was designed in accordance with Military Handbook 1037/3.

6.7.2 Clubhouse and Appurtenances

The existing clubhouse (mobile home) is in fair condition and will need to be replaced as part of the Site 5 restoration effort. The existing clubhouse will be removed from Site 5 for disposal. The existing deck, located adjacent to the clubhouse will also be removed from the site for disposal.

The clubhouse also includes two vaults, one for storage of guns and one for storage of ammunition and valuables. Both vaults are reportedly Class 5 vaults. The vault for storage of guns reportedly has a weight of approximately 1,200 pounds. The second vault, used for storage of ammunition and valuables, reportedly has a weight of approximately 2,000 pounds.

A building to replace the existing clubhouse has not been selected at this time. A 15-foot wide by 70-foot long concrete pad has been included in the design for restoration of the trap/skeet range. Details of the new clubhouse will be incorporated into the final design as a separate submittal.

6.7.3 Paving

The majority of the target flight zone (assumed to be approximately 100 yards for a trap/skeet range configuration) and the trap/skeet shooting positions will be paved to enable periodic cleanup of lead shot, clay pigeon fragments, and shotgun shell wadding (shooting debris) generated in the trap/skeet range as a result of shooting events.

The paving will be installed over the regraded cap surface as indicated on the drawings.
The asphalt paving will include the following components, in ascending order:

- A roadway stabilization geotextile
- A 10-inch asphalt base/subbase course
- A 2-inch asphalt surface course

The paved area will be sloped to permit drainage of stormwater from the paved areas. An asphalt curb will be installed at the perimeter of the paved area to control stormwater flow and prevent shooting debris from leaving the paved area. Inlets with a sump (bottom elevation lower that the outlet pipe) will be installed at downgradient points in the paved area to prevent discharge of shooting debris from the paved area during storm events. The inlets will be located just outside the low permeability layer of the cap and will outlet to the perimeter ditches. The shooting debris will collect in the sump of the catch basin where it can be removed periodically.

Light trucks are typically used on the existing trap/skeet range to deliver clay pigeon targets to the target launching facilities. The asphalt paving was designed to support car and light truck traffic. The pavement design calculations are presented in Appendix K. Since the area where shooters take position will also be paved, the actual shooting positions will be painted on to the asphalt as indicated on the drawings.

Concrete support pads will be installed within the trap/skeet range to support the high house, low house, sporting clay houses, and related structures. The top-of-pad elevation of these concrete pads will be at or above the level of the surrounding paving.

6.7.4 Utilities

ELECTRIC

B&R Environmental performed a preliminary cost analysis for routing electric service to the trap/skeet range at Site 5. This cost analysis included routing the electric service using the existing route as well as routing the electric service along the existing access road to Site 5. B&R Environmental determined that the existing route was more cost effective and the design drawings reflect this routing.

A new 400-amp electric service (single phase) will be installed to the clubhouse. The new electric service will be installed between the existing supply pole near Asbury Avenue and the clubhouse area using a routing scheme as indicated on the drawings.

The 400-amp service will be terminated at the clubhouse at a service disconnect box. A 42-slot service panel will also be installed to supply electric to the new clubhouse, the trap/skeet range, and the EOD range.

A 100-amp electric service will be supplied to the EOD range from the service panel at the new clubhouse. Electric service to the EOD range will be terminated at a service disconnect box to be located adjacent to the existing EOD bunker.

TELEPHONE

Telephone service is currently supplied to the clubhouse via an underground cable installed adjacent to the access road to the trap/skeet range. From the clubhouse, telephone service is also supplied to the EOD range via an underground cable installed along the access road to the EOD range.

The existing telephone lines will be replaced with new telephone lines (installed underground) as part of the site restoration efforts. Details of the new telephone service are described on the drawings.

WATER

No changes to the potable water service will be required. Potable water to the new clubhouse will be supplied by the existing bottled water supplier. Water for non-potable uses will continue to be supplied by the existing portable tank which will be parked on a concrete pad adjacent to the new clubhouse.

GAS

The heating system for the new building has not been specified at this time, although gas (propane) fuel is preferred and is currently used for the existing clubhouse. A concrete support pad has been included on the drawings with the assumption that propane gas will be used as part of the future heating system for the clubhouse. The heating system will need to be approved by explosives safety personnel.

WASTEWATER

The existing on-lot septic system will be replaced with a separate holding tank. This tank will require periodic removal of wastewater and solids by a vacuum truck or similar equipment.

Shooting events are held periodically at the trap/skeet range, when up to 100 people may attend. At other times, there are no personnel at the trap/skeet range with the exception of an occasional visitor.

To estimate the size of the wastewater holding tank, it was assumed that up to 100 people would attend a shooting event at the trap/skeet range. The NJDEP requires a design capacity of 10 gallons/capita/day(event) of wastewater storage for periodic recreational facilities. Therefore, the wastewater capacity of the holding tank was estimated at 1,000 gallons (working volume). Additional capacity of approximately 50% (500 gallons) was also assumed for emergency capacity and to provide adequate freeboard above the working volume to allow placement of level alarms. Therefore, the total minimum capacity of the wastewater holding tank was estimated at 1,500 gallons.

The NJDEP requires that wastewater holding tanks be equipped with high level alarms to alert personnel when the tank is full. The NJDEP also requires that wastewater holding tanks be aerated at a rate of approximately 2 cubic feet per minute per 1,000 gallons of capacity. The wastewater holding tank will be equipped with a high level alarm which will alert personnel when the wastewater level in the holding tank has reached a level corresponding to approximately 1,000 gallons. An additional level alarm (high-high) will alert personnel if the level reaches 1,500 gallons in the wastewater holding tank. A small blower will be used to supply the required aeration of the tank and a vent pipe will be installed to provide ventilation of the tank contents. A manway will be installed in the top of the tank to provide access for wastewater removal as well as provide access for maintenance and cleaning.

6.8 OTHER DESIGN REQUIREMENTS

6.8.1 Regulatory Standards

The cap designs for Sites 4 and 5 comply with the disposition of the action-specific ARARs and TBCs as discussed in the FS for Sites 4 and 5.

6.8.2 Groundwater Monitoring Wells

Existing monitoring wells at Sites 4 and 5 will remain as groundwater monitoring wells and will be used as part of the long-term periodic monitoring of each site. Installation of additional groundwater monitoring wells is not planned at this time.

All existing monitoring wells have outer casings that protrude approximately 2 feet above surrounding grade. Monitoring wells located within the boundaries of each landfill cap will extended to match the final cap grades and will be converted to flush mount for ease of cap maintenance. Monitoring wells outside the cap boundaries will remain in their present configuration and will not be modified.

6.8.3 Maintenance and Repair

There should be very little maintenance required for this landfill cap, which will be considered permanent. If unforeseen events ever damage the cap components, the damaged area would be uncovered and the damaged geosynthetics removed and replaced, as necessary. However, the thickness of this cap is expected to be sufficient to prevent such an occurrence. It is anticipated that the landfill cap will require mowing twice a year. The paved areas at the trap/skeet range will require periodic resealing.

6.8.4 Wetlands Mitigation

Based on the current cap configurations at Sites 4 and 5, it appears that existing wetlands will be affected at Site 4 as part of the cap installation; however, additional area for wetlands will be created, making the net effect zero. At Site 5, it appears that existing wetlands areas will not be affected during cap installation.

6.8.5 Ordnance Materials

During the test pit investigation, ordnance materials were encountered at both Sites 4 and 5. All of the ordnance materials appeared to be shell casings, shipping containers, and other components. No unexploded ordnance (UXO) materials were encountered.

EOD personnel will be available when intrusive activities in areas where ordnance materials were encountered. If ordnance-type materials are encountered, EOD personnel will inspect the materials and will determine the proper method for disposal.

APPENDIX A

GEOTECHNICAL BORING LOGS - SITE 4

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55

BORING NUMBER: 04-6B-01
DATE: 6-17-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	1.0	3 / 5			Loose	orange-brown	Silty Fine grained	SM	Dry				
1032	2.0	7 / 9	18/24		Med. Dense		Sand (some clay)						
S-2 @	3.0	7 / 8											
1036	4.0	7 / 9	13/24			Grayish brown	(bands)						
S-3 @	5.0	6 / 8				Grayish orange	(banding)		moist				
1038	6.0	7 / 7	13/24										
S-4 @	7.0	7 / 7											
1040	8.0	6 / 6	18/24				Silty Med.-Coarse sand (banding)						
S-5 @	9.0	5 / 5					Silty Fine grained sand		moist				
1042	10.0	6 / 5	16/24				Silty very fine to fine grained sand						
S-6 @	11.0	7 / 8											
1044	12.0	8 / 9	16/24										
S-7 @	13.0	5 / 7							moist				
1047	14.0	8 / 9	16/24				(bands)						
S-8 @	15.0	8 / 9											
1105	16.0	11 / 9	17/24										
S-9 @	17.0	9 / 10							moist				
1114	18.0	14 / 13	21/24				Silty Fine grained sand (banding)						
S-10 @	19.0	13 / 16											
1124	20.0	13 / 12	17/24				(less bands)		moist				
S-11 @	21.0	13 / 20			Dense								
1134	22.0	25 / 22	17/24				Silty Fine to coarse grained sand						
S-12 @	23.0	31 / 45			very Dense	Gray	(with gravels)						
1147	24.0	85 / 60	18/24			grayish orange	Silty F-C gr. sand (some gravel)		moist orange mottles very moist				

Sample

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA
2" ID Split spoon Samplers
Collected sample 04-GB01-2224

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X

Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04-GB-01
DATE: 6-17-97
GEOLOGIST: Paul Davis
DRILLER: Steve Burner / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-13 @	25.0	17 / 33			very Dense	Gray(ish) orange	Silty fine to medium	SM/SP	wet				
1158	26.0	53 / 55	18/24		↓	↓	grained Sand (some coarse)						
S-14 @	27.0	26 / 33				Brown	Silty fine grained Sand		Saturated				
1210	28.0	43 / 61	24/24			orange	Silty F-M gr. sand pink/orange/gray VFG sand						
S-15 @	29.0	18 / 40				Orange Pink	Silty fine to coarse		Saturated				
1224	30.0	40 / 54	23/24		↓	↓	grained Sand	↓					
							- EOB -						

Sample

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA Collected 04-GB01-2830
2" ID Split spoon Samplers

Drilling Area Background (ppm):

Converted to Well: Yes ___ No X Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55

BORING NUMBER: 04 - GB - 02
DATE: 6-17-97
GEOLOGIST: Paul Davis
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	1.0	2 / 2			loose	Grayish orange	Silty fine grained	SM					
1406	2.0	3 / 4	17/24		↓		sand	↓	moist				
S-2 @	3.0	5 / 6			Med. Dense		Silty clayey fine	SM/SC					
1408	4.0	7 / 8	19/24				grained sand		moist				
S-3 @	5.0	9 / 9				↓	↓	↓					
1410	6.0	9 / 9	14/24			Gray	Silty very fine	SM					
S-4 @	7.0	7 / 8				↓	grained to fine sand						
1413	8.0	8 / 7	17/24			Grayish orange	↓	↓					
S-5 @	9.0	5 / 6					Silty clayey VFG sand	SM/SC	moist				
1415	10.0	6 / 11	20/24			↓	Silty very fine gr. sand	SM					
S-6 @	11.0	8 / 9				Gray							
1418	12.0	13 / 10	18/24										
S-7 @	13.0	7 / 7				Grayish orange	(Trace of clay)						
1420	14.0	7 / 7	17/24				↓ (Some banding)						
S-8 @	15.0	10 / 11							moist				
1438	16.0	12 / 10	15/24			↓	Silty very fine grained to fine grained sand		moist				
S-9 @	17.0	9 / 13			↓	Tan							
1444	18.0	15 / 16	19/24		Dense	↓	↓						
S-10 @	19.0	13 / 15			Med. Dense	Orange tan	Silty fine grained sand						
1451	20.0	12 / 12	21/24			↓	↓ (Some banding)	↓	wet				
S-11 @	21.0	8 / 9				Gray-brn	Silty clayey VFG sand	SM/SC	wet				
1458	22.0	13 / 14	14/24		↓	Orange brn	Silty fine to coarse sand	SM/SP	Some gravels				
S-12 @	23.0	13 / 20			Dense				Saturated				
1505	24.0	24 / 14	19/24		↓	↓	↓ (Gravelly)	↓					

Sampled

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA
2" ID Split spoon samplers
Collected 04-GB02-1820 for analysis

Drilling Area Background (ppm):

Converted to Well: Yes ___ No X

Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55

BORING NUMBER: 04-GB-02
DATE: 6-17-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
SS13 C	25	11 / 15			Med Dense	Orange brown	Silty F. to C. Sand	SM/SP	Saturated				
1513	26	13 / 17	22/24		Med Dense	↓	Silty fine grained Sand	↓					

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA
2" ID Split spoon Samplers

Drilling Area Background (ppm):

Converted to Well: Yes ___ No X

Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04-GB-03
DATE: 6-18-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	1.0	2 / 4			loose	orange brown	Silty fine grained	SM	Dry				
0835	2.0	3 / 2	14/24				sand						
S-2 @	3.0	4 / 6											
0837	4.0	7 / 14	19/24		med. Dense	Gray orange			moist				
S-3 @	5.0	8 / 8				orange	Silty Clayey fine	SC	3" wet zone				
0839	6.0	9 / 9	13/24				grained sand						
S-4 @	7.0	8 / 9				gray to orange	Silty fine	SM					
0842	8.0	9 / 9	17/24				grained sand		moist				
S-5 @	9.0	5 / 6					Silty clayey fine	SC	4" wet zone				
0845	10.0	7 / 7	20/24				grained sand						
S-6 @	11.0	8 / 9					Silty fine grained	SM					
0848	12.0	10 / 11	17/24				sand (banding)		very moist				
S-7 @	13.0	9 / 7											
0904	14.0	9 / 9	18/24				(orange bands)		moist				
S-8 @	15.0	8 / 9					some coarse sand						
0911	16.0	11 / 14	18/24				Silty F-C gr. sand	SM/SP	moist				
S-9 @	17.0	13 / 17			Dense	Gray	Silty F-C gr. sand		very moist				
0921	18.	24 / 32	18/24		very Dense	orange	Silty F.G. sand	SM	(orange iron dep. lens)				
S-10 @	19.	11 / 17			med Dense	Gray to orange	(some coarse)						
0927	20.	29 / 25	17/24		very Dense				very wet				
S-11 @	21.	11 / 17			med Dense				saturated				
0933	22.	22 / 24	16/24		Dense								
S-12 @	23.	20 / 30			very Dense		Silty F-C gr. sand	SM/SP	Saturated				
0943	24.	32 / 31	19/24		very Dense		(some gravel)						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA   collected 04-GB03-1224 for analysis
2" ID Split spoon Samplers

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X Well I.D. #: N/A

APPENDIX B

SOIL BORING LOGS - SITE 4 (PREVIOUS INVESTIGATIONS)

US NAVY
1771-02 ...

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

FILE

WELL NUMBER: 4-1

LOCATION: Landfill west of D group

SURFACE ELEVATION: 173.00'

OWNER: WPNSTA - EARLE

ADDRESS: COLTS NECK NEW JERSEY

TOTAL DEPTH: 30'

WATER LEVEL: 18'

DRILLING COMPANY: JE Fritts

DRILLING METHOD: Auger

DATE DRILLED: 1/8/86

DRILLER: WL

HELPER: RI

LOG BY: AEB

SKETCH MAP

NOTES: "Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Brownish yellow (10YR 6/6) medium sand, some coarse sand
5		28	SS	6 8 11 13	5'-7' Light gray (10YR 7/1) medium sand, some (10%) fine sand, moist, Rec=12".
10		29	SS	8 15 37 41	10-12' White (10YR 8/1) and brownish yellow (10YR 6/6) medium sand with 10% fine sand, moist, Rec = 12"
15					15'-17' Brownish yellow (10YR 6/6) medium to coarse sand, trace (5%) gravel becoming strong brown (7.5YR 4/6) medium to coarse sand, moist, Rec = 18"
20					

* ASTM D1586

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: 4-1
OWNER: WPNSTA-EARLE
LOCATION: Landfill west of D Group
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 30'
SURFACE ELEVATION: 173.00'
WATER LEVEL: 18'
DRILLING COMPANY: JE Fritts
DRILLING METHOD: Auger
DATE DRILLED: 1/8/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20		31	SS	11 10 19 21	20'-20.5' 2" strong brown (7.5YR 4/6) medium sand over 4" white (10YR 8/1) very coarse sand and gravel.
					20.5'-21.5' Layered, firm fine to medium sand, trace gravel (5%), saturated Rec=18"
25		32		WOR 10 23	25'-27' 2" brown (10YR 4/3) medium to fine sand over 16" of white (10YR 8/1) and brownish yellow (10YR 6/6) fine and medium sand / coarser with depth, Saturated, Rec = 18"
30		33			30'-30.5' Very pale brown (10YR 7/4) fine sand
					30.5'-31' Layered light gray (10YR 7/1) and brownish yellow (10YR 6/6) fine sand.
					31'-31.5' 4" Light gray (10YR 7/1) silt over 2" brownish yellow (10YR 6/8) clay, Saturated, Rec = 18"

* A.S.T.M. D1586

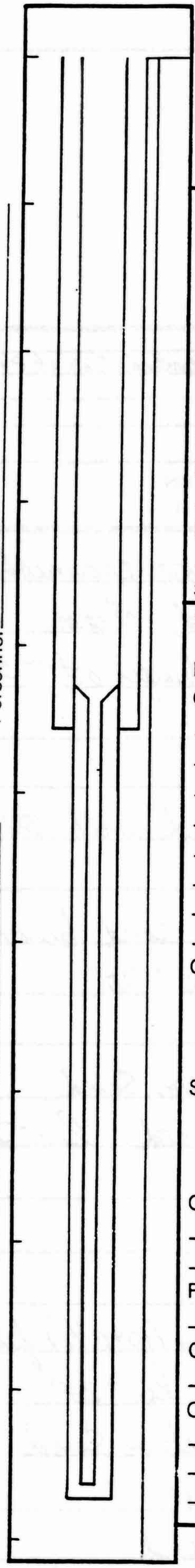
Well 4-1

Well Construction Summary

Location or Coords: Landfill West of D Group

Elevation: Ground Level ______

Top of Casing 173.00'



Location ______
Personnel ______
Project ______

Drilling Summary:

Total Depth 30'

Borehole Diameter ______

Driller J.E. Fritts

Rig Mobil Drill B-61

Bit(s) Hollowstem Auger, Roller Bit

Drilling Fluid Water

Surface Casing 6" Steel Locking

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

3' -	GS+2'	C1	30' -	15'	S
15' -	GS+2'	C2	-		

Casing: C1 6" Steel

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material #2 Ottawa Sand 30' - 12.5' below GS

Cement 6:1 Portland cement: bentonite 10' - GS

Other Bentonite Pellets 12.5' - 10' below GS

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/8/86	1440	1/8/86	1515
Roller Bit	"	1515	"	1530
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1530	"	1600
Filter Placement:	"	1600	"	1730
Cementing:	1/9/86	0830	1/9/86	0915
Development:	3/21/86	1410	3/21/86	1600
Other:				

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: 4-2
OWNER: WPNSTA-EARLE
LOCATION: Landfill west of D group
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 18'
SURFACE ELEVATION: 152.36'
WATER LEVEL: 4'
DRILLING COMPANY: JE Fritts
DRILLING METHOD: Auger
DATE DRILLED: 1/9/86
DRILLER: WL
HELPER: RI
LOG BY: AFB

SKETCH MAP

NOTES:
"Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Dark brown (10YR 3/3) becoming brownish yellow (10YR 6/6) medium sand, clean. Glauconitic medium sand layer at ~3'. Soil wet at ~4'.
5		34	SS	10 10 11 22	5-5.5' Yellow (10YR 7/8) coarse sand with 50% gravel.
					5.5'-7' Yellow (10YR 7/8) fine to coarse sand becoming finer with depth, wet. Rec = 20"
10		35	SS	9 11 19 27	10'-12' Yellow (10YR 7/8) fine to medium sand, trace (10%) gravel, saturated, Rec = 20".
15		36	SS	7 6 7 11	15'-16.5' Gray (10YR 7/1) to brownish yellow (10YR 6/6) fine to medium sand, saturated, Rec = 24"
					16.5'-17' Reddish yellow (7.5YR 6/8) fine to medium sand
18		37	SS	2 3 3 5	18'-19' Reddish yellow (7.5YR 6/8) clayey silt
					19'-19.4' Light gray (10YR 7/1) very fine sand
20					19.4-20' Reddish yellow (7.5YR 6/8) clay. Saturated. Rec. = 24"

* A.S.T.M. D1586

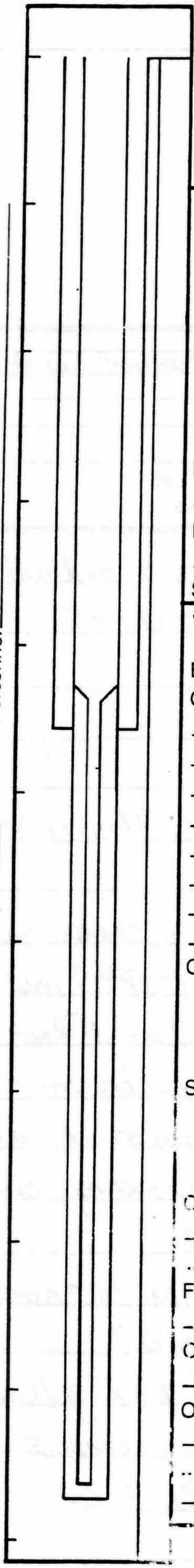
SHEET 1 OF 1

Well 4-2

Well Construction Summary

Location or Coords: Landfill West of D Group

Elevation: Ground Level ______
Top of Casing 152.36'



Location ______
Personnel ______
Project ______

Drilling Summary:

Total Depth 18'
Borehole Diameter ______
Driller J.E. Fritts
Rig Mobil Drill B-61
Bit(s) Hollow stem Auger, Roller Bit
Drilling Fluid ______
Surface Casing 6" Steel Locking

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/9/86	1350	1/9/86	1500
Roller Bit	"	1500	"	1515
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1515	"	1530
Filter Placement:	"	1530	"	1700
Cementing:	"	1700	"	1715
Development:	3/21/86	1225	3/21/86	1345
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

2'	GS+3'	C1	18'	3'	S
3'	GS+2'	C2			

Casing: C1 6" Steel

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material #2 Ottawa Sand 18'-2.5' below GS

Cement 6:1 Portland cement: bentonite 2'-GS

Other Bentonite Pellets 2.5'-2' below GS

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: 4-3
LOCATION: Landfill west of D group
SURFACE ELEVATION: 166.40'

OWNER: WPNSTA-EARLE
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 25'
WATER LEVEL: 12'

DRILLING COMPANY: JE Fritts
DRILLING METHOD: Auger
DATE DRILLED: 1/10/86
DRILLER: WL
HELPER: RI

LOG BY: AEB

SKETCH MAP

NOTES: "Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Brownish yellow (10YR 6/6) fine to medium sand. Light gray (10YR 7/1) at 4.5'.
5		38	SS	4 7 17 22	5'-5.5' White (10YR 8/1) and brownish yellow (10YR 6/6) fine to medium sand. 5.5'-6' Reddish yellow (7.5YR 6/8) medium to coarse sand. 6'-6.5' White (10YR 8/1) and yellowish red (5YR 5/8) medium to very coarse sand + gravel (5%), moist, Rec = 18"
10		39	SS	15 24 32 30	8.5'-10.5' Layered white (10YR 8/1) and brownish yellow (10YR 6/2) fine to medium sand and coarse sand to gravel alternating, moist, tip of spoon damp, Rec = 18"
15		40		12 24 18 18	13.5'-14' Reddish yellow (7.5YR 6/8) fine to coarse sand, trace (5%) gravel (up to 1/2"). 14'-15.5' Brownish yellow (10YR 6/6) and yellowish red (5YR 5/8) medium to very coarse sand, 20% gravel, saturated, Rec = 22"
20					

* A.S.T.M. D1586

WESTON DESIGNERS CONSULTANTS

US NAVY
1771-02-10
FILE

DRILLING LOG

WELL NUMBER: 4-3
OWNER: WPNSTA-EARLE
LOCATION: Landfill west of D Group
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 25'
SURFACE ELEVATION: 166.40'
WATER LEVEL: 12'
DRILLING COMPANY: JE Frits
DRILLING METHOD: HSA
DATE DRILLED: 1/10/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

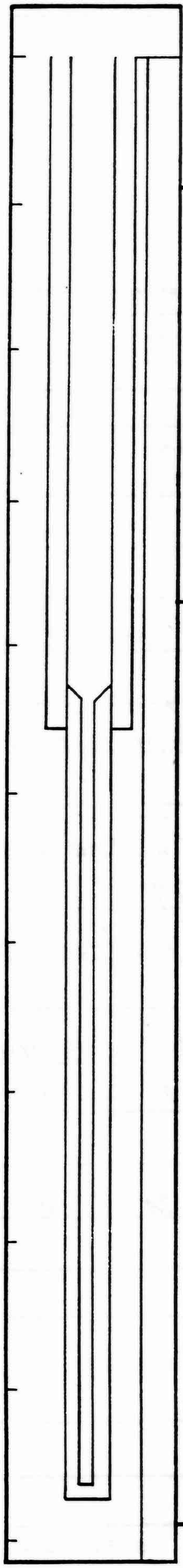
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
15					
		41	SS	10 12 32 38	18.5'-19' Brownish yellow (10YR 6/6) very coarse sand and gravel (up to 1/2").
20					19'-20' Brownish yellow (10YR 6/6) fine to medium sand
					20'-20.5' Light gray (10YR 7/1) fine to medium sand, saturated, Rec. = 24"
		42		8 14 19 27	23.5'-24' Brownish yellow (10YR 6/6) medium to very coarse sand.
25					24'-25' Brownish yellow (10YR 6/6) fine to medium sand, some reddish yellow (7.5YR 6/8) mottles.
					25'-25.5' Light gray (10YR 7/1) fine sand, clean, saturated, Rec = 24"

* A.S.T.M. D1586

SHEET 2 OF 2



Location
Personnel
Project

Well 4-3

Well Construction Summary

Location or Coords: Landfill West of D Group

Elevation: Ground Level

Top of Casing 166.40'

Drilling Summary:

Total Depth 25'

Borehole Diameter

Driller J.E. Fritts

Rig Mobil Drill B-61

Bit(s) Hollowstem Auger, Roller Bit

Drilling Fluid Water

Surface Casing 6" Steel Locking

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C=Casing S=Screen

3'	GS+2'	C1	25'	10'	S
10'	GS+2'	C2			

Casing: C1 6" Steel

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2

Centralizers

Filter Material #2 Ottawa Sand 25'-8' below GS

Cement 6:1 Portland cement: bentonite 6'-GS

Other Bentonite Pellets 8'-6' below GS

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/10/86	1015	1/10/86	1145
Roller Bit	"	1315	"	1330
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1330	"	1400
Filter Placement:	"	1400	"	1530
Cementing:	"	1530	"	1550
Development:	3/21/86	1050	3/21/86	1215
Other:				

Well Development:

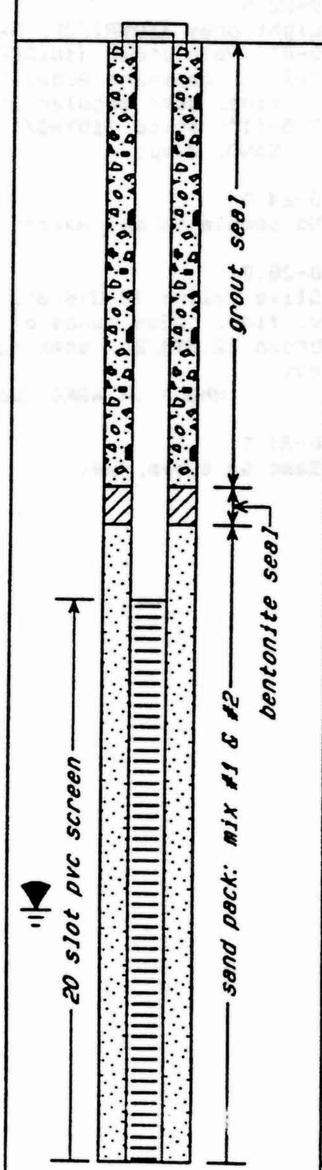
Comments:

WESTON DESIGNERS CONSULTANTS

MONITOR WELL 4-4

Project: N.W.S. Earle/ Colts Neck	Well Number: MW04-4
Location: Colts Neck, N.J.	Coordinates:
Geologist: T. McCann	Top of Casing Elevation: 181.28 feet MSL
Drilling Contractor: B. L. Myers	Groundsurface Elevation: feet
Driller: B. Stringer	Total Borehole Depth: 35.5 feet
Drilling Method: Hollow stem auger	Total Well Depth: 35.0 feet
Diameter of Borehole: 11.5 (7.5) inches	Date Started: 1/30/91
Diameter of Well Casing: 4 inches	Date Well Completed: 2/08/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0–2	X	2,3 / 5,5	79	SM
2–4	X	4,5 / 4,7	67	GM
4–6	X	3,6 / 7,11	50	
6–8	X	2,6 / 10,11	79	SM
8–10	X	4,8 / 8,9	71	
10–12	X	6,10 / 10,10	75	
12–14	X	3,9 / 9,14	75	
14–16	X	9,10 / 16,11	81	
16–18	X	4,11 / 14,14	75	
18–20	X	10,21 / 21,30	73	
20–22	X	15,29 / 30,38	46	GM
22–24	X	9,34 / 50,99/4		
24–26	X	7,9 / 16,23	88	GM
30	X	5,8		GM

DESCRIPTION

0.0-2.0
0-6": Very dark brown (10YR2/2), SAND, fine, some Silt, loose, moist.
6-19": grading to a Dark grayish brown (10YR4/2), SAND, v.f. to fine, some SILT, loose, moist.
HNU = BKG

2.0-4.0
Yellowish brown (10YR5/8), SAND, some Silt, little fine-med. Qtz gravel, subrounded, Fe staining, at 2.5-3.5 ft. tan SAND, v. fine, some Silt, moist.
HNU = BKG

4.0-6.0
Same as above, little fine to coarse Sand moist.

6.0-8.0
Yellow (10YR8/6), SAND, v. fine, some Silt, banding apparent at 6-6.5ft and 13-13.5ft, both Yellow (10YR7/6), moist.

8.0-10.0
Reddish yellow (7.5YR6/8), SAND, v.f., some Silt, grading to Brownish yellow (10YR6/8) at 9.5-17", moist.

10.0-12.0
10-10.5': Brownish yellow (10YR6/8), SAND, v. fine, some Silt, 2" layer of Dark brown (10YR3/4), SAND, v. fine, some Silt, moist.
10.5-11.5': Very pale brown (10YR7/4), SAND, some Silt, v.f., loose, moist.

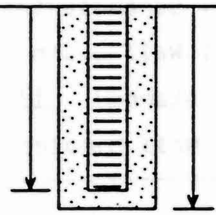
12.0-14.0
Very pale brown (10YR7/4), Sand, v. fine, some Silt, grading to Very pale brown (10YR8/4) at 11.5-18". moist.

14.0-16.0
Very pale brown (10YR8/4), SAND and SILT, v. fine, mottled color throughout, strong band of Yellow (10YR7/8) at 6.5-7.5", moist.

MONITOR WELL 4-

PROJECT N.W.S. Earle/ Colts Neck

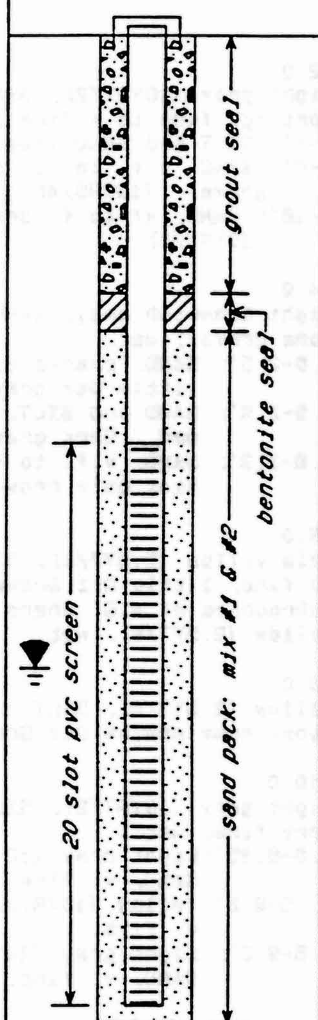
WELL NUMBER MW04-4

DEPTH IN FEET	WELL CONSTRUCTION DETAIL	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL	DESCRIPTION
30		X	17,28		GM	16.0-18.0 Very pale brown (10YR7/3), SAND, v. fine, some Silt, uniform, no banding, little Qtz gravel @ 13-14.5", rounded, moist.
32						
34						18.0-20.0 Very pale brown (10YR7/4), Sand, some Silt, little gravel, subrounded, SAND: 80% fine, 15% med., 5% crse, banding: 4-5": (10YR7/6), 12.5-13.5": (10YR8/1), 15.5-16": (10YR7/8), moist.
36						
38						20.0-22.0 Light gray (10YR7/2), SAND, some Silt, 0-2": Pale brown (10YR6/3) SAND, v.f., 7-7.5": dominant Reddish yellow (5YR6/8), fine, some angular Qtz gravel. 7.5-11": White (10YR8/1), fine-med., SAND, damp.
40						
42						
44						22.0-24.0 No sample taken. Hammer lost in hole.
46						24.0-26.0 Olive yellow (2.5Y6/8), SAND and SILT, v. fine, .25mm bands of Very dark grayish brown (2.5Y3/2), some rounded Qtz gravel, wet. HNU = .4 ABKG (spoon)
48						
50						29.0-31.0 Same as above, wet.
52						
54						
56						
58						
60						
62						
64						
66						
68						
70						

MONITOR WELL 4-5

Project	N.W.S. Earle/ Colts Neck	Well Number	MW04-5
Location	Colts Neck, N.J.	Coordinates	
Geologist	J. Williams	Top of Casing Elevation	165.28 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	26.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	26.0 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	2/20/91
Diameter of Well Casing	4 inches	Date Well Completed	2/20/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0–2	X	1,9 / 15,13	92	SM
2–4	X	11,13 / 14,11	71	SM
4–6	X	5,8 / 7,10	46	SM
6–8	X	6,16 / 12,21	62	SM
8–10	X	8,10 / 21,26	54	GM
10–12	X	9,14 / 28,20	71	GM
12–14	X	14,16 / 16,10	58	GM
14–16	X	9,12 / 16,18	62	GM
16–18	X	9,11 / 11,13	62	GM

DESCRIPTION

0.0-2.0
Dark brown (10YR4/3), SAND, med. w/ some coarse grains, Black silt layer (10YR2/1), moist.

2.0-4.0
Grayish brown (10YR5/2), SAND, med. and coarse grain, poor sorting, some fine Qtz gravel, moist.

4.0-6.0
Reddish brown (5YR5/4), SAND, fine - med. grain, Fe staining, trace fine gravel, moist.
HNU = BKG

6.0-8.0
Reddish brown (5YR5/4), SAND, f-m, trace fine to med. Qtz gravel, Fe staining, moist.

8.0-10.0
Reddish brown (5YR5/4), SAND, fine - med. little fine to med. Qtz gravel, subangular, Fe staining, dk. brown silt streaks, moist.

10.0-12.0
Reddish brown (5Yr5/4), SAND, fine to med., some f-m subangular Qtz gravel, seams of Fe stains, moist.

12.0-14.0
Pink (5YR7/3), SAND and Qtz GRAVEL, fine to med., poor sorting, moist.

14.0-16.0
Reddish brown (5YR5/4), SAND, fine to coarse, and Qtz GRAVEL, f-m, Fe staining, wet @15'.

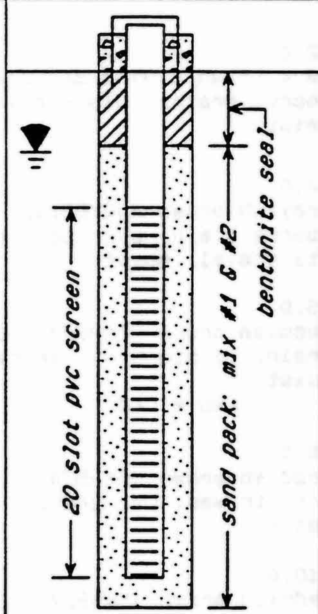
16.0-18.0
Brownish yellow (10YR6/8), SAND, fine, at 17ft there is 2" band coarse SAND and fine GRAVEL, loose, wet.

* Discontinue split spooning due to running sands. Drill to 27 ft.

MONITOR WELL 4-(

Project	N.W.S. Earle/ Colts Neck	Well Number	MW04-6
Location	Colts Neck, N.J.	Coordinates	
Geologist	T. McCann	Top of Casing Elevation	149.75 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	14.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	13.7 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	2/25/91
Diameter of Well Casing	4 inches	Date Well Completed	2/25/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0–2	X	5,6 / 5,6	75	SP
2–4	X	6,10 / 12,15	75	GM
4–6	X	10,16 / 17,17	54	
6–8	X	10,12 / 17,17	71	
8–10	X	8,10 / 11,12	63	SM

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

DESCRIPTION

0.0-2.0
Light gray (10YR7/2), SAND, med. to poor sorting, fine to v.fine grain, damp:
0-1": SILT and SAND loam.
1-5": SAND, v.f. to f., some med. Qtz. gravel, (10YR6/4)
5-18": SAND, vf to f, some med. Qtz grvl. (10YR7/2)

2.0-4.0
Light brownish gray, SAND, some Silt, some gravel, wet:
2.0-2.5': SAND, coarse to fine, poor sort, little Qtz gravel, med.,
2.5-2.8': SAND and SILT, some Qtz gravel, med., Dark gray (10YR4/1).
2.8-3.3': SAND, v.f. to f., some Qtz grvl., Very pale brown (10YR7/4).

4.0-6.0
Pale yellow (2.5Y7/4), SILT and SAND, v.f. to fine, little Qtz Gravel, med. grain, subrounded at 4.9' where color grades to Yellow (2.5Y7/6), wet

6.0-8.0
Yellow (2.5Y7/6), SILT and SAND, v.f. to fine, some medium Qtz Gravel, wet

8.0-10.0
Light gray (10YR7/2), SILT and SAND, very fine, wet:
8.0-8.35': Light gray (10YR7/2), SILT and SAND, v. fine, well sorted.
8.35-8.6': Yellow (10YR7/6), SILT and SAND v. fine.
8.6-9.2': Light gray (10YR7/2), SILT and SAND, v. fine, well sorted.

APPENDIX C

GEOTECHNICAL LABORATORY RESULTS - SITE 4

VALLEY FORGE LABORATORIES, INC.

30th ANNIVERSARY 1967 1997

Engineering Consultants Since 1967

SOIL LABORATORY TEST REPORT 6-6

RECEIVED JUL 02 1997

Project No. 97128
June 30, 1997

Geotechnical Engineering

Attention: Mr. Dan Witt
Brown and Root Environmental
661 Andersen Drive
Foster Plaza 7
Pittsburgh, PA 15220

Construction Quality Control

Re: Subcontract Agreement No. GCDB-97-526-1298, Analytical Services
CTO No. 289 - Naval Weapons Station (NWS), Earle Colts Neck, N.J.

Samples Picked Up: On 6/23/97 by VFL, 9 samples from 18 jars

Laboratory Testing

Testing Completed: (As requested on Chain of Custody Form, 4 Samples at Level D P.P.E. and 5 Samples at Level C P.P.E.)

NDT and Related Services

Test	ASTM Standard
Natural Moisture Content	D2216
Particle Size Analysis (Sieve and Hydrometer)	D422
Atterberg Limits	D4318
USCS Classification	D2487

Research and Special Studies

Results:

The results of the testing are graphically depicted on the attached Grain Size Distribution Curves. If you have any questions about this test report, please call.

Environmental Engineering

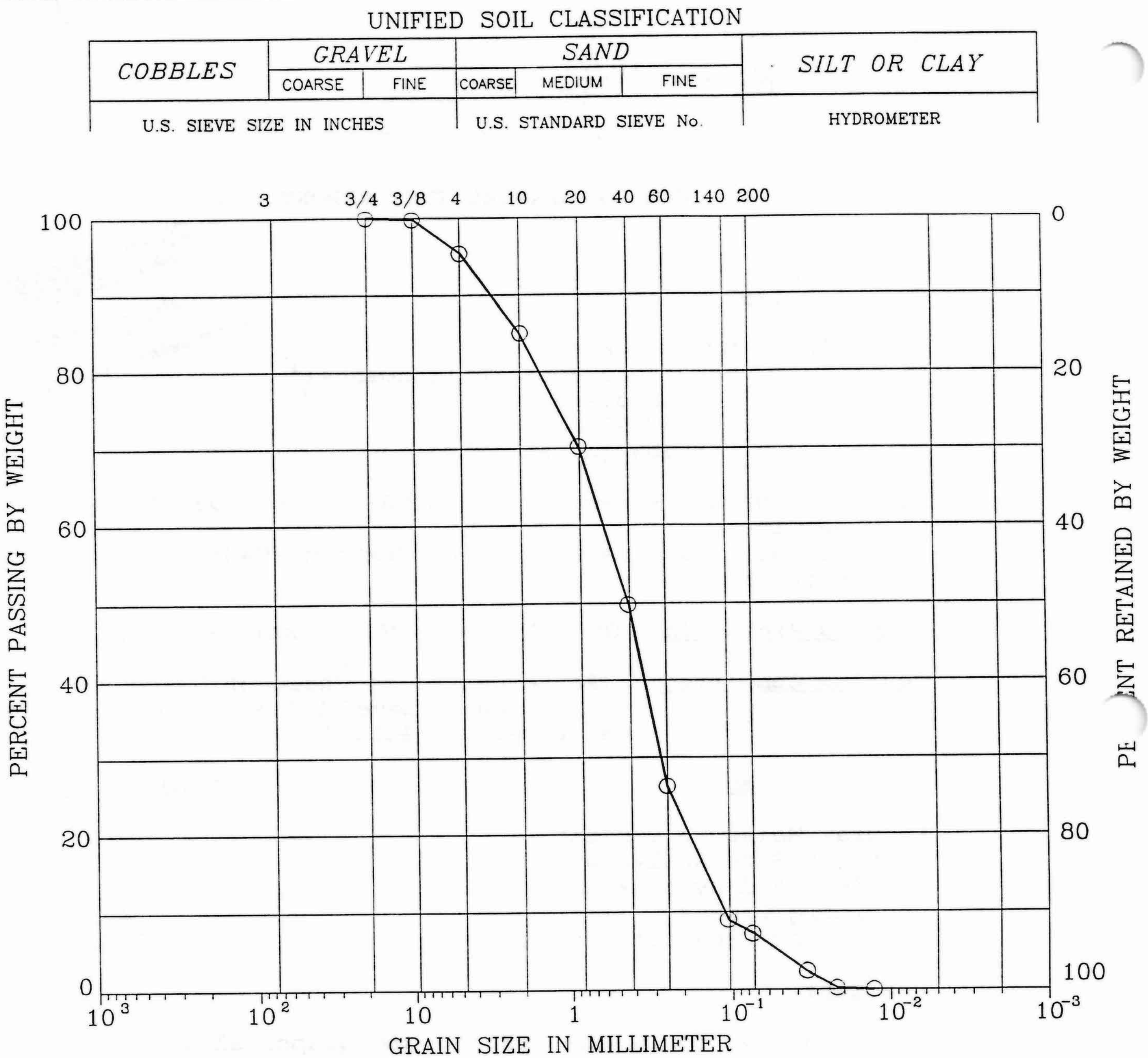
Sincerely,

Eric J. Seksinsky

Eric J. Seksinsky, P.G., P.E.
Technical & Quality
System Manager

Transportation and Traffic Engineering

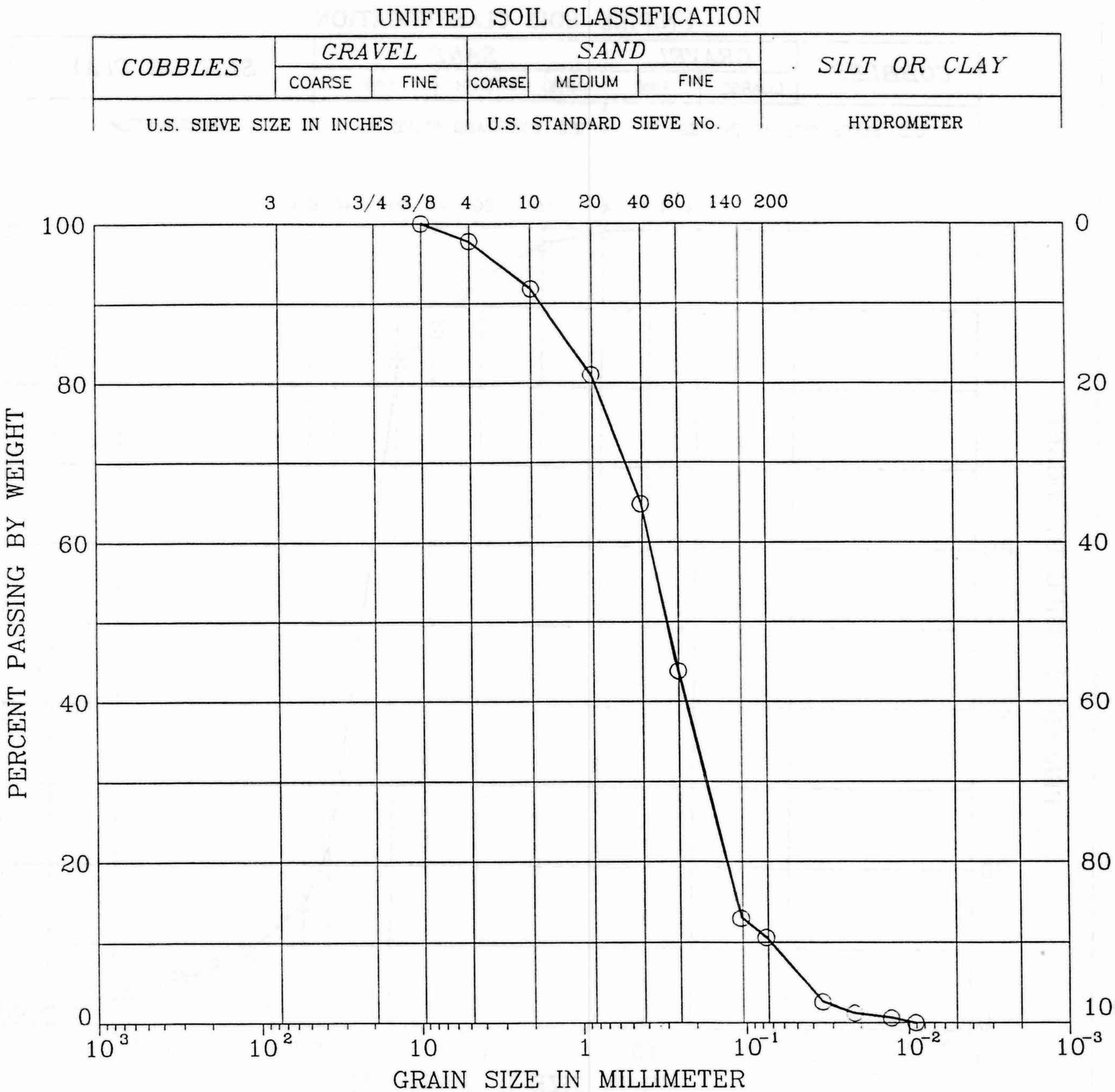
EJS:lcw
Enclosure
cc: Mike Wireman



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	04-GB01-2224	NON-PLASTIC		TAN POORLY-GRADED SAND WITH SILT (SP-SM)

Remark : NAT. MOISTURE CONTENT 5.4 LEVEL D P.P.E.

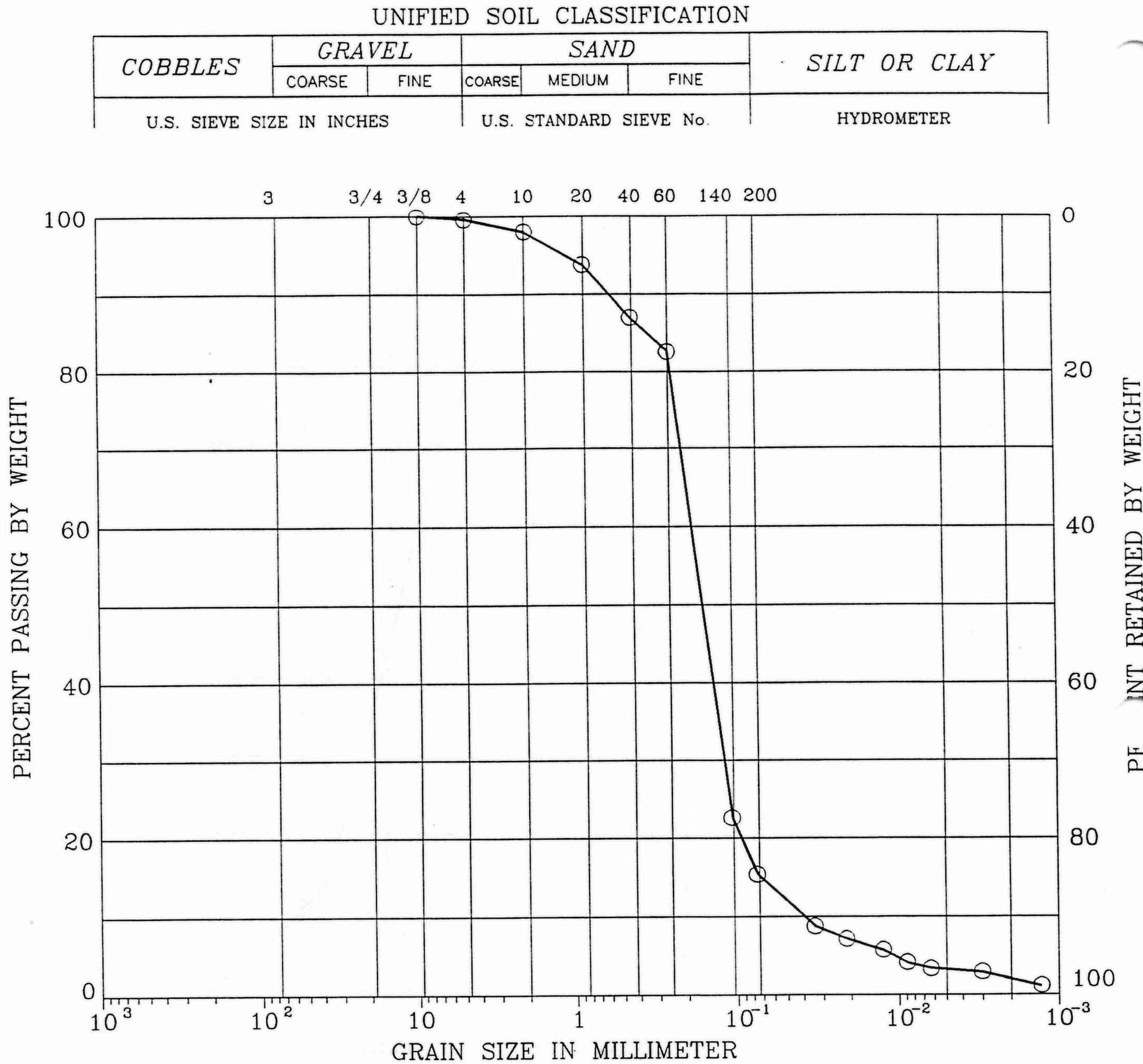
Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	04-GB01-2830	NON-PLASTIC		TAN POORLY-GRADED SAND WITH SILT (SP-SM)

Remark : NAT. MOISTURE CONTENT 11.9 LEVEL D P.P.E.

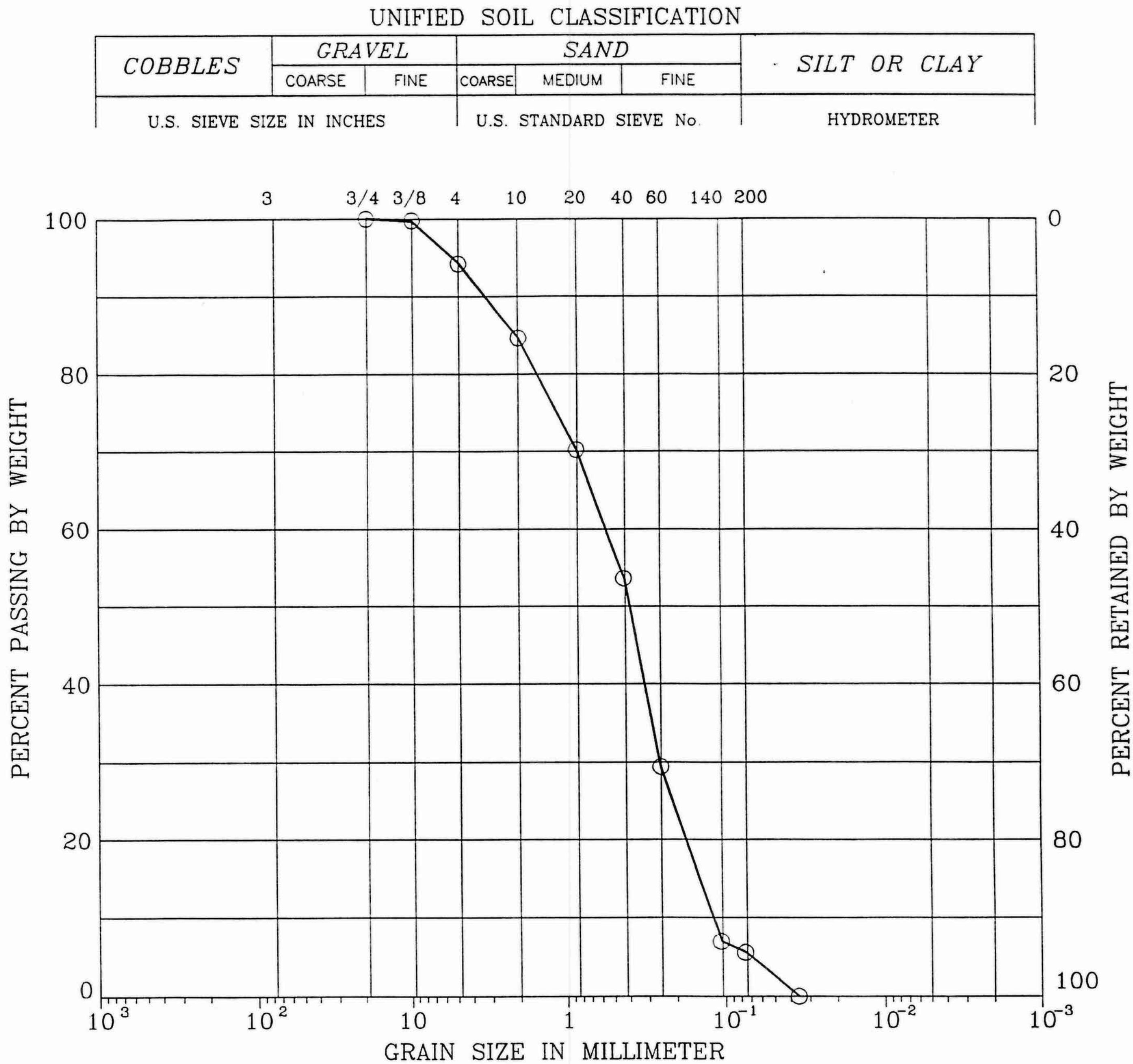
Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
O	04-GB02-1820	NON-PLASTIC		TAN SILTY SAND (SM)

Remark : NAT. MOISTURE CONTENT 12.5

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	04-GB03-2224	NON-PLASTIC		TAN POORLY-GRADED SAND WITH SILT (SP)

Remark : NAT. MOISTURE CONTENT 14.1 LEVEL D P.P.E.

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97

APPENDIX D

TEST PIT LOGS - SITE 4

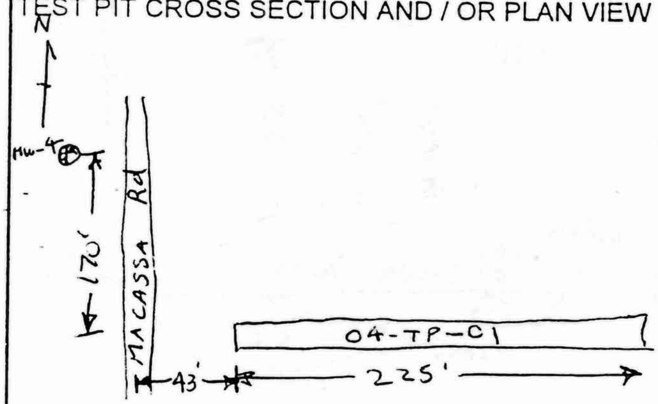
TEST PIT LOG

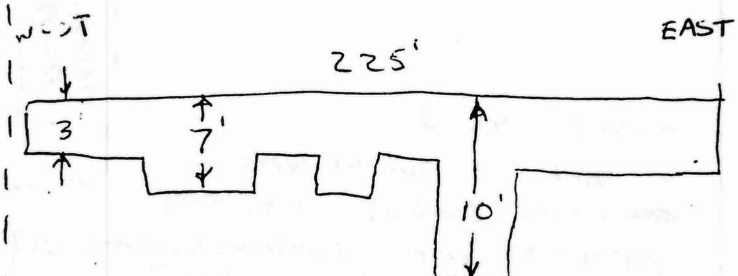
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-01
DATE: 6/17/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		- ORANGE SANDY SOIL				
		APPEARS UNDISTURBED				
	10' END OF TEST TRENCH					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





TEST TRENCH ENDED BEFORE HITTING WASTE BECAUSE BACK-HOE COULD NOT ADVANCE PAST TREES

REMARKS: TRENCH DUG CONTINOUSLY, OCCASSIONALLY GOING DEEPER TO 7'-10' DEEP, ALL CLEAN SAND

BEGIN TRENCH 10:30
12:45 BREAK FOR LUNCH

PHOTO LOG: PICTURES #1, 2, 3

11:00 HNU READING 0 BREATHING ZONE/SPOIL PILE
11:20 " " " " " " "
11:40 " " " " " " "

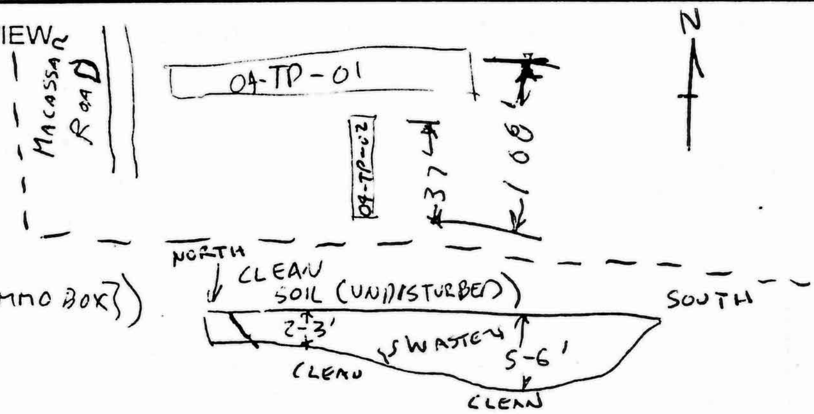
BEGIN BACKFILL TRENCH 13:45
FINISH BACKFILLING 15:40

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: 04-TP-02
TEST PIT NUMBER: 04-TP-02
DATE: 6/17/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		METAL WASTE WITH				
		BROWN SILTY SAND				
		DEPTH OF WASTE ≈ 5-6'				
		END OF TRENCH NEAR 04TP-01				
		AGAIN REACHED ORANGE SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW



TEST PIT BEGUN
AT AREA OF SURFACE WATE
~~CAN~~ METAL BANDING, SMALL PIPES
BATTERIES (EMPTY CONTAINERS [AMMO BOX])
ELECTRONICS IN PLASTIC BAGS?

REMARKS:
10:05 NO HNUS READING BREATING ZONE / SPOIL PILE
10:15 " " " " " "
10:25 " "

PHOTO LOG: #4 04TP-02

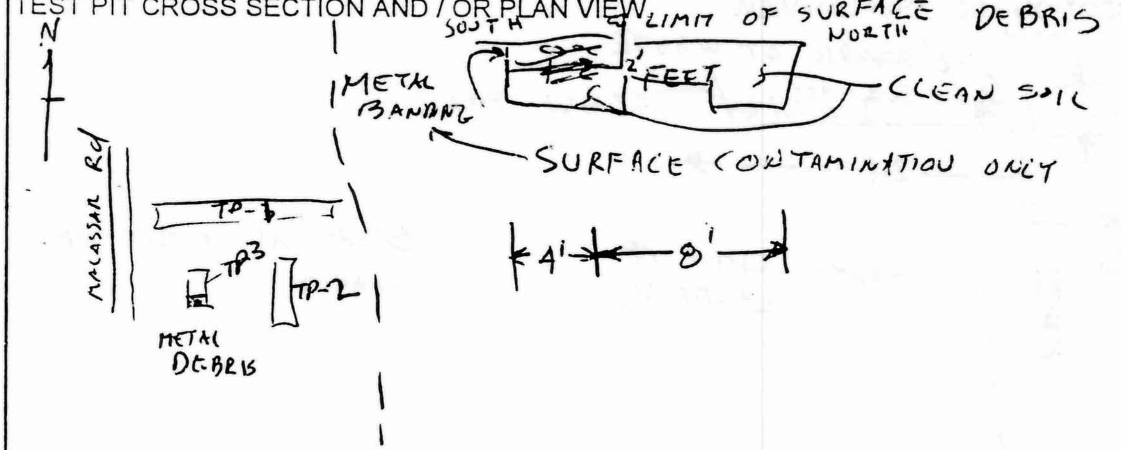
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: 04-TP-03

TEST PIT NUMBER: 04-TP-03
DATE: 6/18/97
GEOLOGIST: DCW

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		BROWN SAND WITH				
	2'	METAL BANDING				
	END OF	METAL DEBRIS				
	TEST	CLEAN SOIL BELOW				
	PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS:

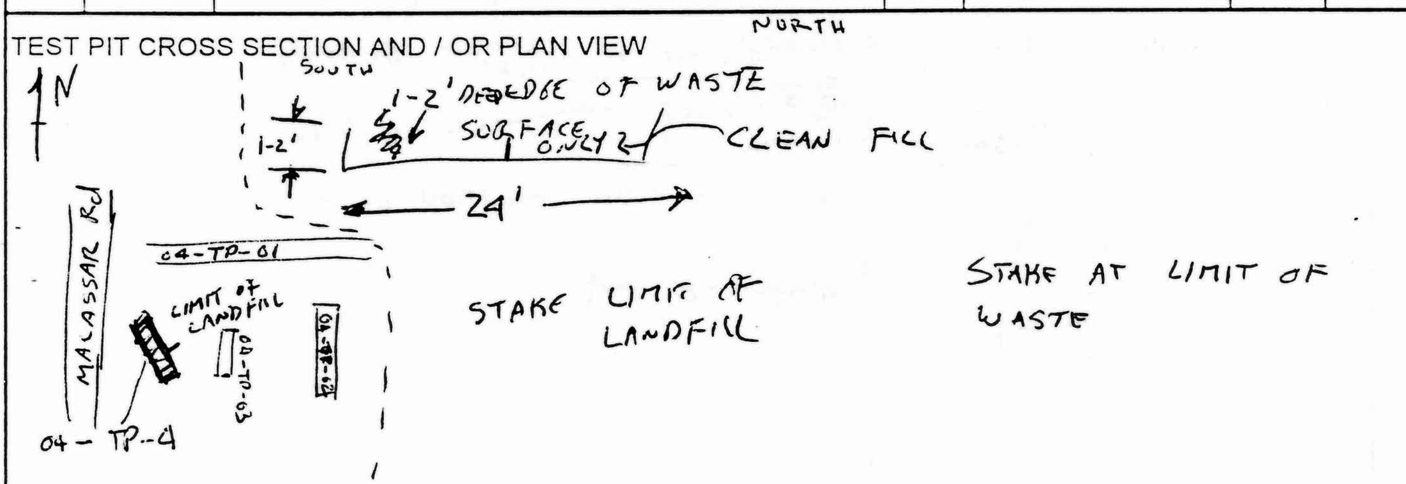
PHOTO LOG:

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-04
DATE: 6/18/97
GEOLOGIST: DCW

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		BROWN SAND METAL				
	2'	DEBRIS				
	END OF TEST PIT	CLEAN SOIL				

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: PHOTO 5 TP-04

PHOTO LOG:

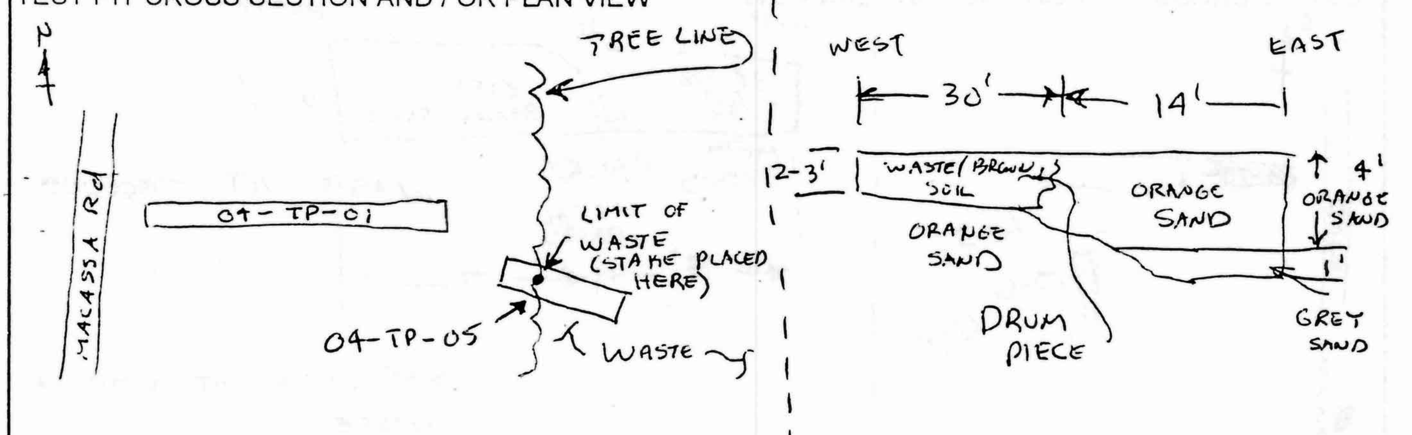
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-05
DATE: 6/18/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SAND WITH				
		METAL DEBRIS				
	3'					
	4'	ORANGE SAND CLEAN				
	5'	GREY SAND CLEAN				
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: BEGIN 9[15]
FINISH BACKFILL 10[35]

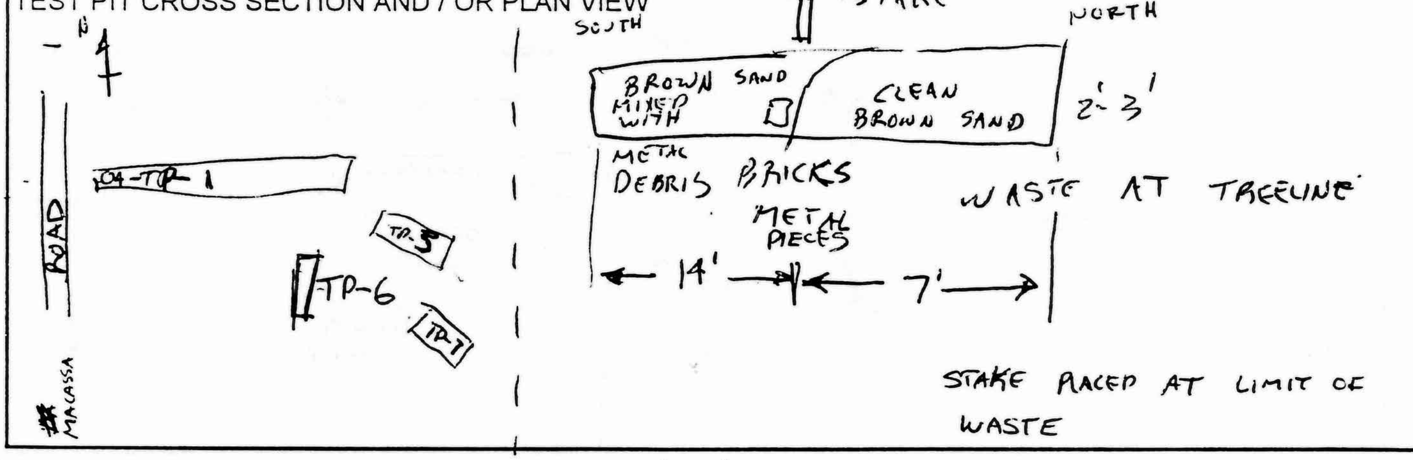
PHOTO LOG: # ~~5~~-6, 7,8 PIPE ~~LIEING~~ LYING ACROSS TRENCH
9[95] HNU 0 READING BREATHING ZONE/SPOIL PILE
10

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-06
DATE: DCW 6/18/97
GEOLOGIST: DAN WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		BROWN SOIL (SAND)				
		MIXED WITH METAL DEBRIS				
	3'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: TRYED TEST PIT COULD NOT REACH THE END (NO H...
MOVED TRENCH 11 AM NO HNUS REA...
READIN

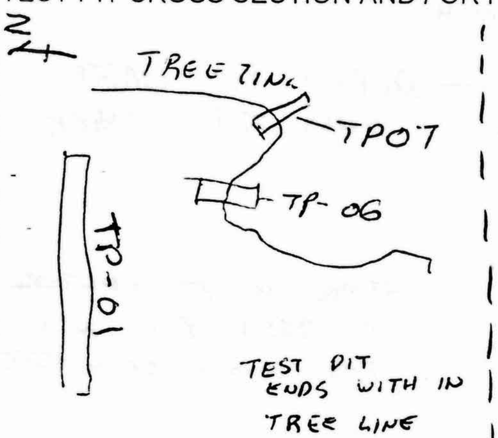
PHOTO LOG:

TEST PIT LOG

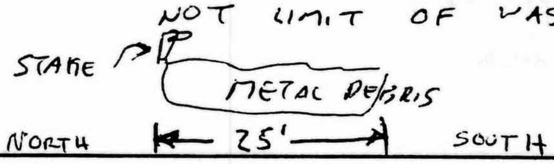
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 6/18/97
DATE: 04-TP-07
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		BROWN SOIL (SAND)				
	2-3'	METAL DEBRIS				
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



- TEST PIT ADVANCE AS FAR AS POSSIBLE
- TREES STOPPED ADVANCE OF BACKHOE
- METAL DEBRIS AT END OF TRENCH CONTINUES INTO TREES FURTHER
- STAKES AT THE LIMIT OF T.P. NOT LIMIT OF WASTE



REMARKS:

PHOTO LOG:

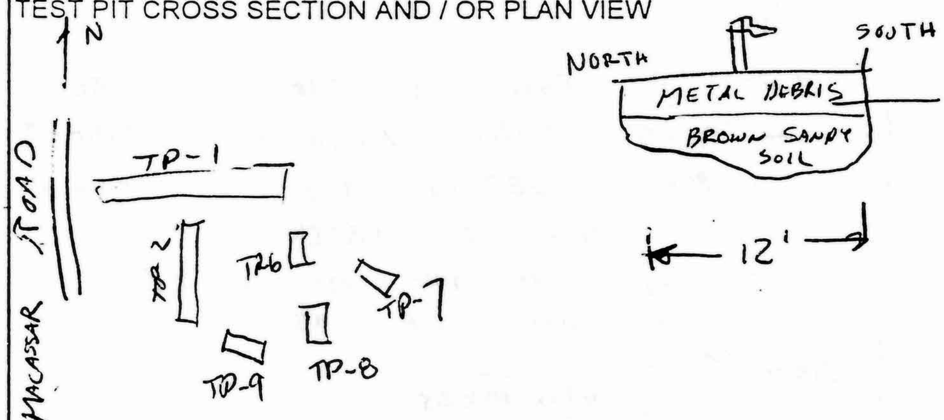
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04- TP-08
DATE: 6/18/97
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SANDY SOIL				
		METAL DEBRIS				
	3'					
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



DEPTH OF WASTE ONLY ≈1' THICK

STAKE IS AT CENTER OF TEST PIT NOT THE LIMIT OF WASTE

REMARKS:

PHOTO LOG:

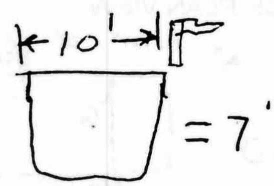
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7603
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-09
DATE: 6/18/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN/BLACK SANDY SOIL				
		WITH DEBRIS				
	7'					
	END OF PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



SEE PREV. TEST PIT LOG 04-TP-08 FOR LOCATION

METAL DEBRIS
BLACK SOIL
HNUS READING 0
MISC. MATERIAL

START 12:30
FINISH BACKFILLING 1300

CANNOT PROCEED FURTHER BECAUSE OF TREES

REMARKS: STAKE IS AT LIMIT OF TRENCH NOT LIMIT OF WASTE

PHOTO LOG:

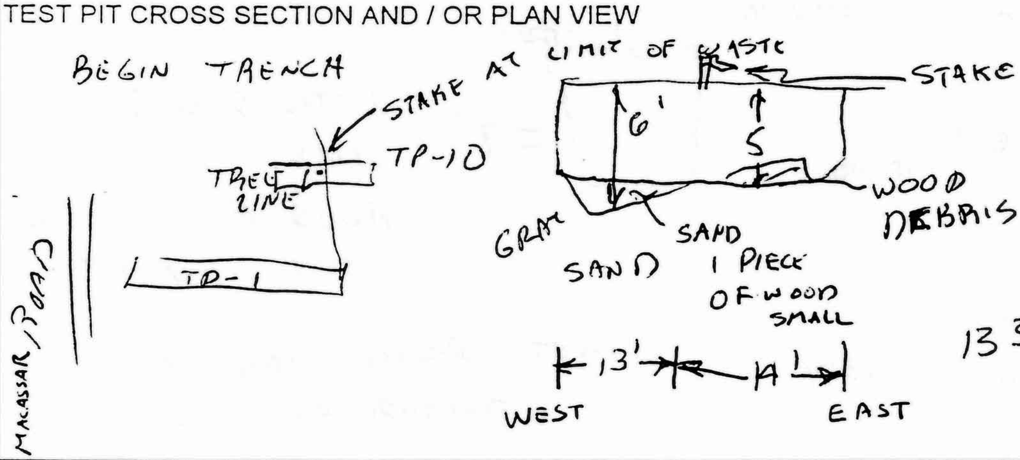
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-10
DATE: 6/18/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		ORANGE ~~[illegible]~~ SAND				
	4'					
		WASTE DARK BROWN				
	5'	WOOD				
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



13 20 HNUS READING = 0 IN SPOIL PILE AND ~~WASTE~~ PIT

REMARKS: BEGIN 13 10 13 20 – 13 38 BREAK FOR LUNCH
WASTE JUST INSIDE OF TREELINE

PHOTO LOG:

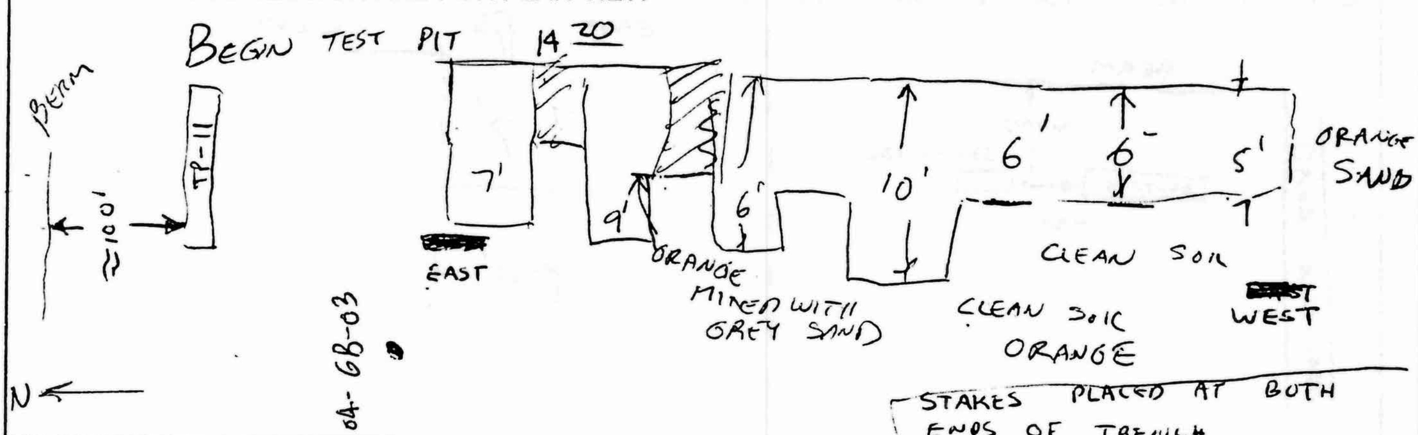
TEST PIT LOG

4 50 BACK

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-11
DATE: 6/18/97 6-19-97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		ORANGE SAND CLEAN				
	6'					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: SOME SURFACE DEBRIS NO WASTE FOUND, PIT BACKFILLED WILL CONTINUE TOMARROW
RESUME 09-TP-11 @ 8 15 6/19/97

PHOTO LOG: #9 10' DEEP SECTON
#10 7' DEEP SECTON TP-12

HNUS READING = BACKGROUND 9
6/19/97

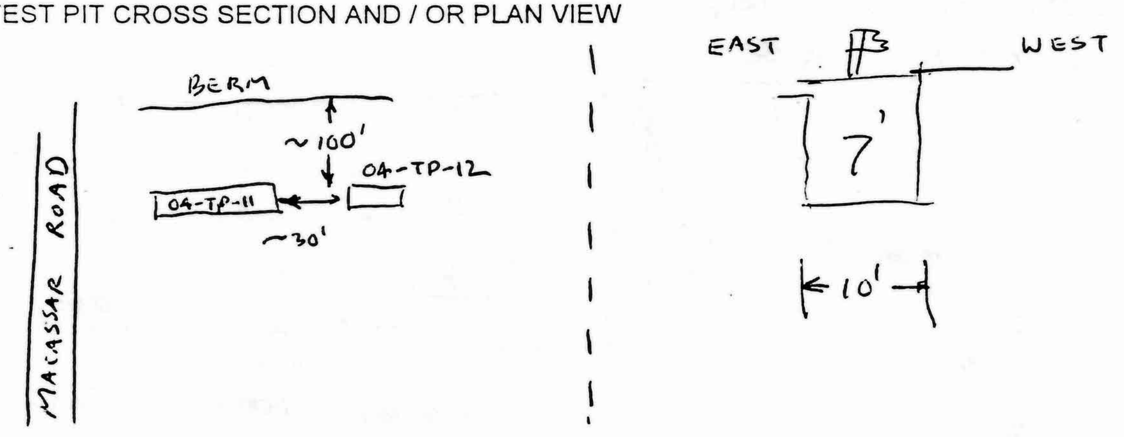
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-12
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		ORANGE CLEAN SAND				
		NO DEBRIS				
	7' END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



9:30 AM BEGIN

REMARKS:

PHOTO LOG: #10 7' DEEP SECTION

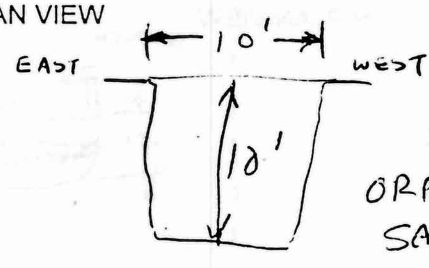
TEST PIT LOG

PROJECT NAME:	NWS EARLE	TEST PIT NUMBER:	04-TP-13
PROJECT NUMBER:	7602	DATE:	6/19/97
LOCATION:	SITE 4	GEOLOGIST:	D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	BZ (ppm)
		ORANGE SAND SOME				
		GREY SAND				
	10'					
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE TEST PIT LOG FOR 4-TP-14 FOR PLAN OF RELATIVE LOCATIONS OF TEST PITS



BEGIN PIT 9³⁰

BEGIN BACK FILL 9⁵⁰

FINISH PIT 10⁰⁰

ORANGE SAND NO DEBRIS

REMARKS:

PHOTO LOG:

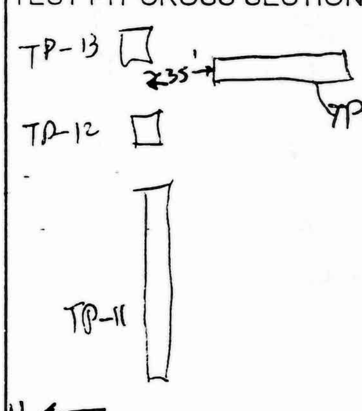
TEST PIT LOG

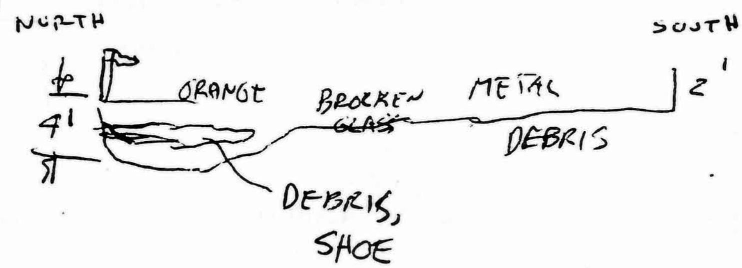
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-14
DATE: 6/19/97
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	 BZ (ppm)
		BROWN SANDY SOIL				
		WITH DEBRIS				
	4'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





STAKE PLACED AT THE LIMIT OF WASTE

START 10^{05}

FINISH 10^{30}

REMARKS:

PHOTO LOG: # 11 METAL DEBRIS

12 END OF DEBRIS

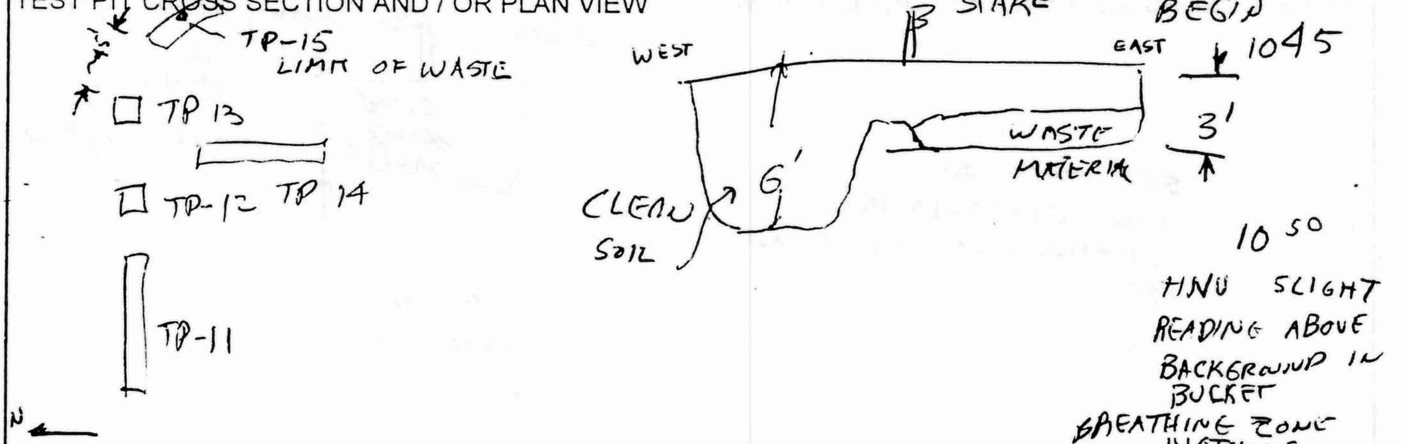
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-15
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
	~~OR~~ PW	ORANGE SAND				
	2'					
		BLACK SOME METAL				
		DEBRIS, WASTE MATERIAL,				
		SOME RAGS				

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: WASTE MATERIAL ENCOUNTERED @ IMMEDIATLY, TEST PIT CONTINUED UNTIL CLEAN FILL LOCATED, TEST PIT DEEPENED TO 6' TO CONFIRM NO WASTE PRESENT.

PHOTO LOG: #13 EAST END OF TRENCH
#14 WASTE MATERIAL IN BUCKET

TEST PIT LOG

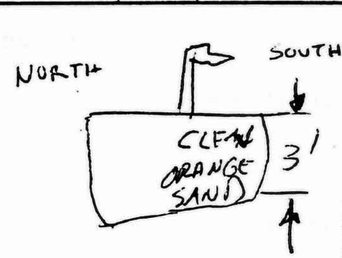
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-16
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		CLEAN ORANGE SAND				
	3'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE TEST PIT LOG 04-TP-17 FOR RELATIVE LOCATIONS OF TEST PITS



STAKE IN CENTER OF PIT

BEGIN 11:10
BEGIN BACKFILL
END 11:20

REMARKS:

PHOTO LOG: #15 CLEAN SAND

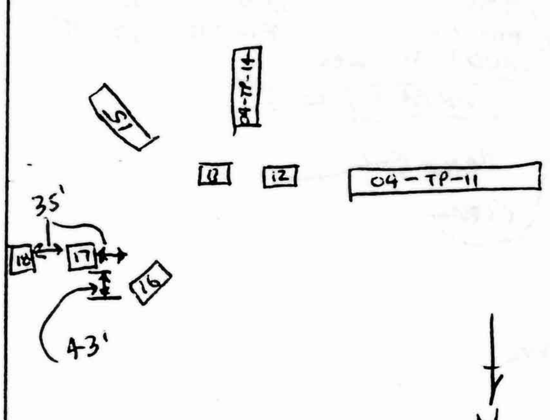
TEST PIT LOG

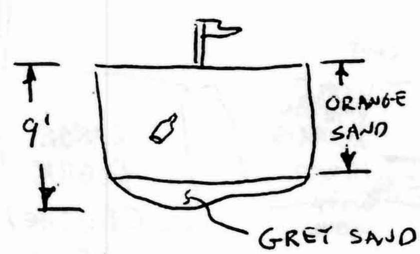
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-17
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		ORANGE SAND				
	8'					
	9'	GREY SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW





FINISH DIGGING TEST PIT/ 11:30
BEGIN BACKFILLING

TEST PIT BACKFILLED 11:45.

TWO BOTTLES FOUND IN PIT

NOTE: STAKE PLACED IN CENTER OF PIT

REMARKS:

PHOTO LOG:

TEST PIT LOG

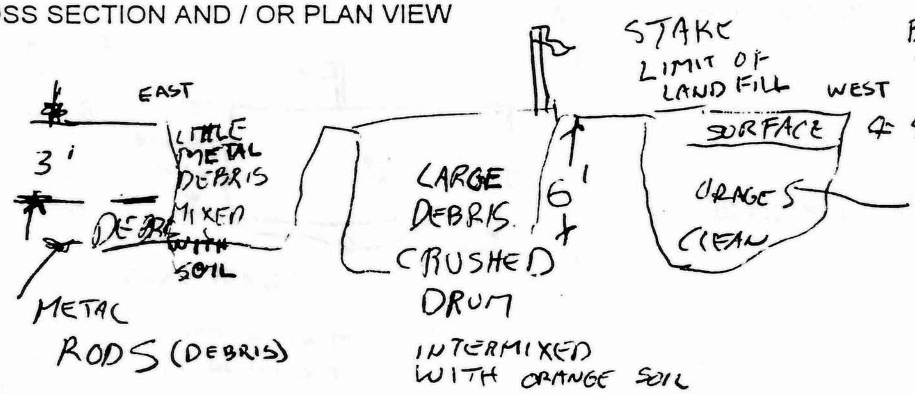
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-18
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SAND				
		GREY SAND				
		~~ORAN~~ SW ORANGE SAND				
		GREY SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE 04-TP-17 LOG FOR RELATIVE LOCATION



BEGIN 12:00
FINISH 12:45

REMARKS:

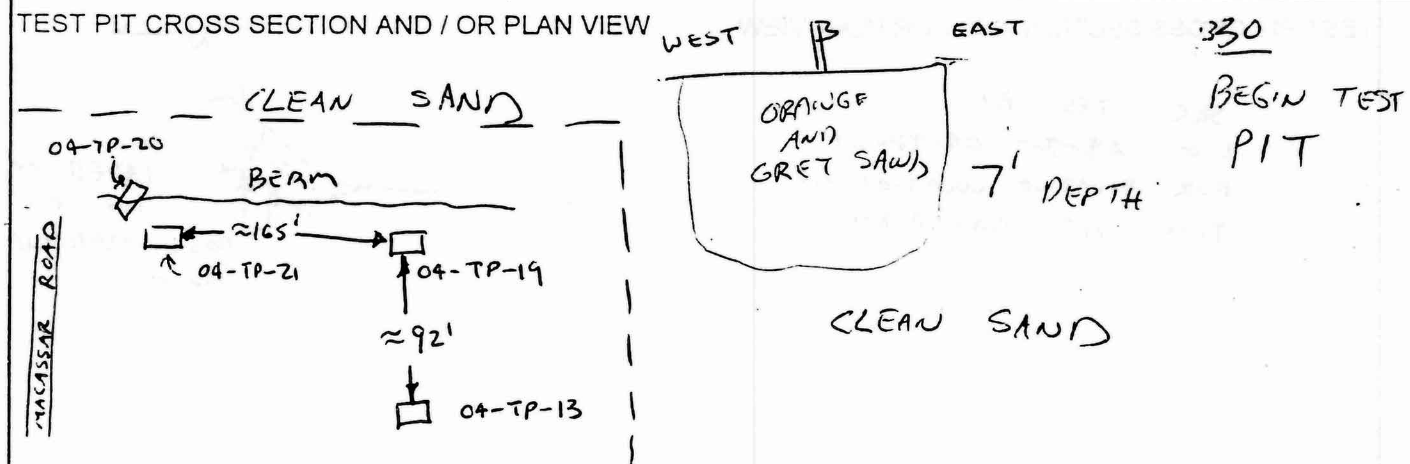
PHOTO LOG: 16 CRUSHED DRUM LOOKING EAST

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 6/19/97
DATE: 04-TP-19
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	BZ (ppm)
		ORANGE SAND WITH				
		STREAKS OF GREY				
	7' END OF T.P.					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: TEST PIT LOCATED NEXT TO BASE OF RIDGE ALONG NORTH END OF SITE 4.

PHOTO LOG: #17 CLEAN SAND LOOKING EAST

TEST PIT LOG

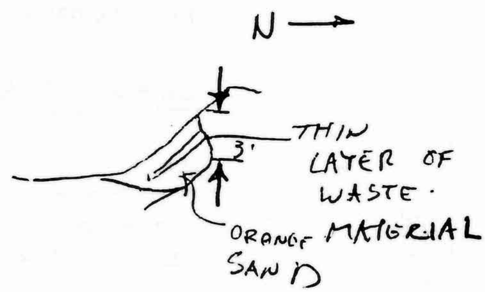
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-20
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
	1'	BROWN SAND				
	6''	SOME DEBRIS METAL BLACK				
		ORANGE SAND				
	3.5'					

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE TEST PIT LOG ~~04-21~~ 04-TP-21 FOR RELATIVE LOCATION OF TEST PIT 04-TP-20



REMARKS:

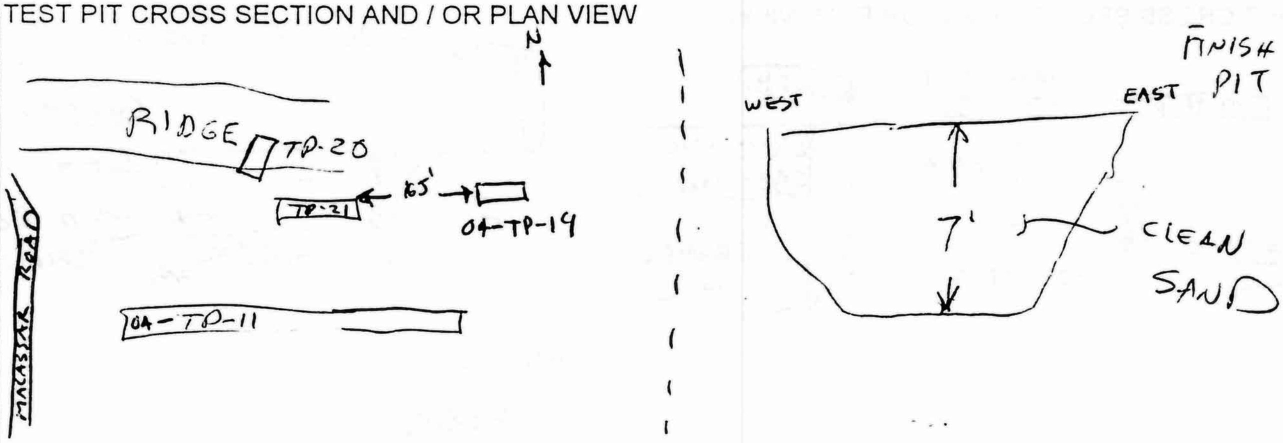
PHOTO LOG: #18 LOOKING NORTH DIGGING INTO BERM

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-21
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
	1.0'	LIGHT BROWN SAND				
		ORANGE SAND				
	7'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



FINISH TEST PIT 14:20

REMARKS:

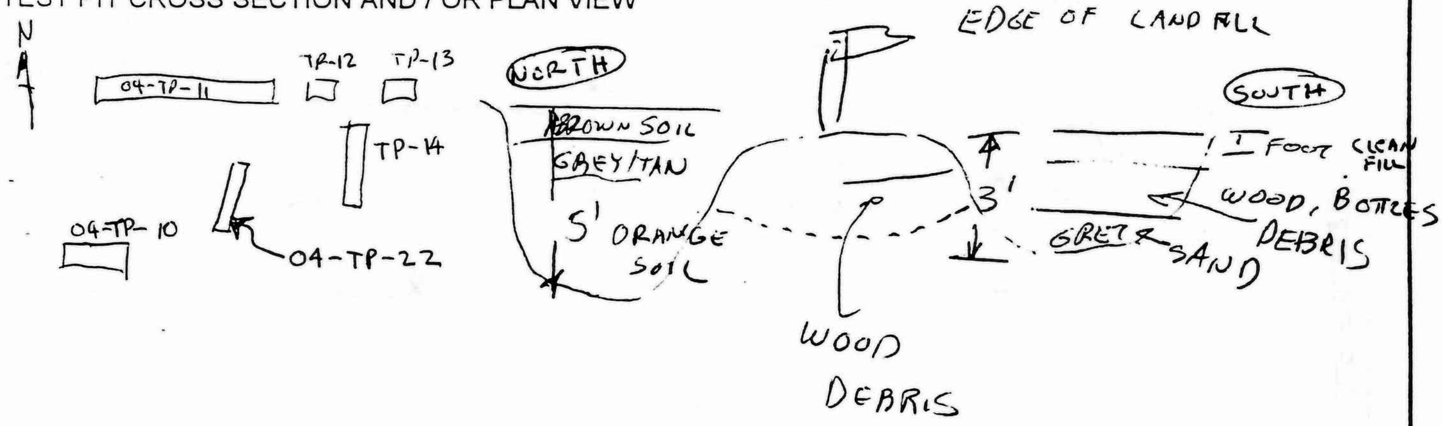
PHOTO LOG:

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-22
DATE: 6/19/97
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
	1'	BROWN SANDY SOIL				
	2'	WOOD DEBRIS, COKE BOTTLE,				
	3'	GREY SAND				
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS:

PHOTO LOG:

TEST PIT LOG

PROJECT NAME: NWS EARLE

PROJECT NUMBER: 7602

LOCATION: SITE 4

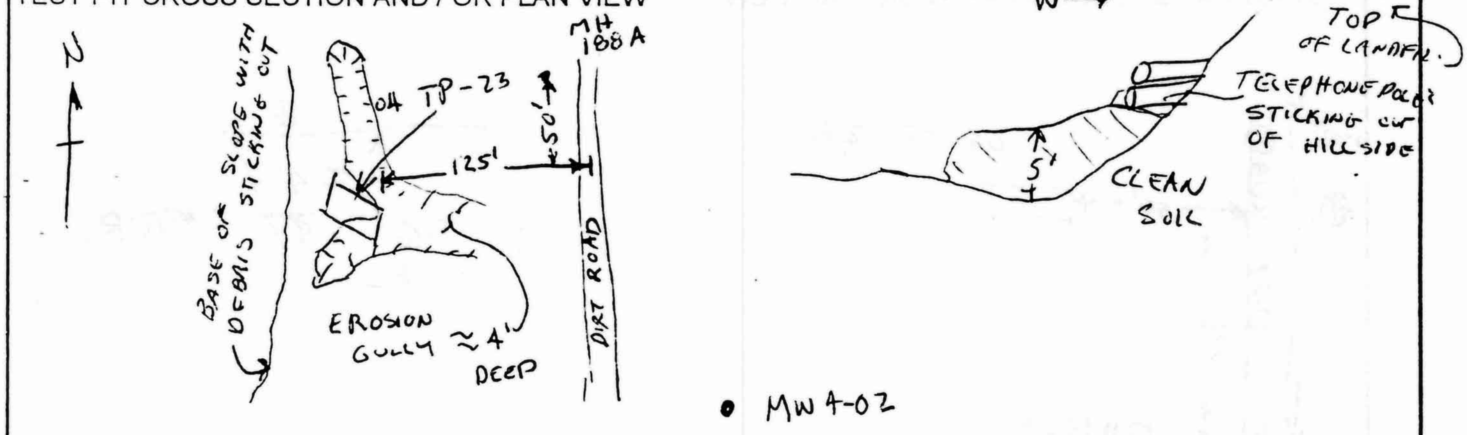
TEST PIT NUMBER: 04-TP-23

DATE: 6/19/97

GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		ORANGE SAND				
	3'					
		GREY SAND				
	5'					
	BOTTOM OF DW ~~BORING~~ TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS:

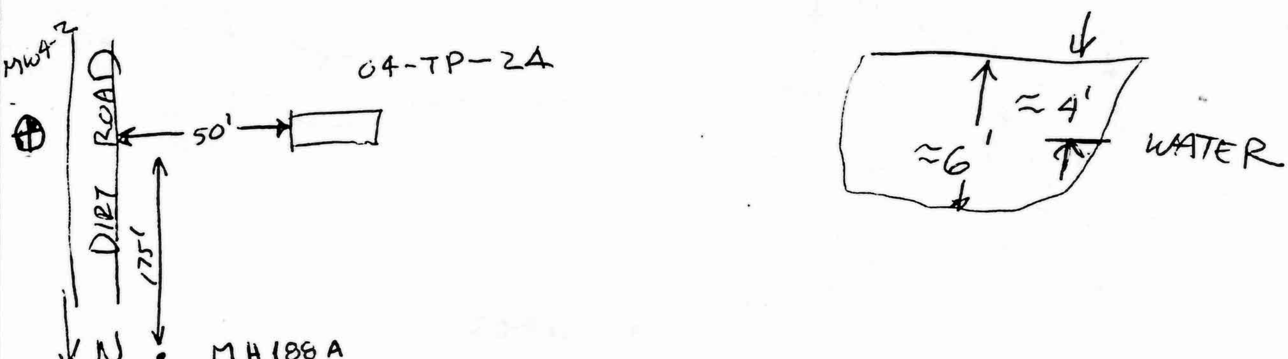
PHOTO LOG: #19 LOOKING WEST. NOTE! TELEPHONE POLES IN BACKGROUND

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-24
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	BZ (ppm)
		ORANGE SAND				
	2'					
		RED WITH BLACK STREAKS SAND				
	4'	WATER TABLE				
		ORANGE SAND				
	6'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: PIT COLLAPSED UPON SELF BEFORE MEASURING DEPTH

PHOTO LOG: